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JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

AMERICAN REPERTORY

OF

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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JOURNAL
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THE FRANKLIN INSTITUTE
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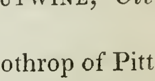
JULY, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the Wooden Aqueduct carrying the Pennsylvania Canal across the river Alleghany, at Pittsburg; from actual measurement. With remarks by John C. Trautwine, *Civil Engineer.*

This aqueduct was built in the year 1829, by Mr. Lothrop of Pittsburg, at an expense to the State of $104,000. It has two abutments, six piers, of stone, and seven arches of timber, of 150 feet clear span each; the whole length of the aqueduct between the abutments being 1092 feet. The masonry is of cut ashlar, in large courses, with rubble filling. The material is a gray sandstone, rather too soft, in my opinion, for such parts of a structure as are exposed to rapid currents, bringing down heavy fields of ice and drift wood, as is the case with the Alleghany. *The piers are seven feet thick on top;* they batter one inch to a foot, on the sides; are semi-circular at their down-stream ends; and are provided (at least those of them which are exposed to the principal force of the current,) with *breakwater* starlings, of this shape, up-stream. (This term is frequently applied to such starlings, but I cannot perceive its propriety; the expression savors of tautology.) The average height of the piers is about forty feet.



The timber of the aqueduct is white pine, with the exception of the *chords* and the *pier-posts*, which are of white oak, as being better calculated to resist the great strains that come upon them. I conceive, however, that any precaution of this kind would apply with more force to the *pole plates,* or cap-pieces, as it is well known that the resistance of timber to compression is much less than that to extension. Therefore, if extra precautions are requisite for the chords, they are doubly so for the poles.

The width of the aqueduct, from out to out of weather boarding, is about thirty-four feet. The height of the trusses, from bottom of chords to top of poles, sixteen feet. The canal trunk has a top width of sixteen feet, a bottom width of fifteen feet, and a depth of five feet. The depth of water is generally four feet; sometimes four feet three inches. There are four trusses to each span. These particulars, however, with the other principal dimensions, are so plainly indicated by the drawings, as to require no further explanation. Throughout the drawings, *the same letters refer to the same parts.*

Table of Scantlings of the Principal Timbers and Irons.

Names of pieces.	References.	Remarks.	Inches.
Arch pieces,	L	six to each truss, or composing each rib; each piece	7×14
Pole, or cap,	J	of inner trusses,	10×15
" " "	F	of outer trusses,	10×12
Chords,	C	of both inner and other trusses, each in two pieces; each piece	7×15
Queen posts,	Q	in body,	9×10
" "	"	in heads and feet,	10×14
Main braces,	S		8×10
Counter braces,	X		8×4½
Butting pieces,	P	at heads of queen posts of outer trusses,	5× 7
" "	T	or straining pieces at heads of queen posts of inner trusses,	5× 7
Diagonal braces,	U	in roof, and under canal trunk,	6× 7
Extra braces,	M	on outer trusses only	6×12
Straining sills to ditto,	*k*		6×10
Straining pieces to "	*f*		6×12
Straining sills to pier posts,	*j*		6×10
Fishing pieces to poles,	*b*	over piers,	6×12
Roof girders,	E		7×12
Floor girders,	G & H		9×18
Additional pieces,	A	under girders marked G only,	9×15
Plank ,		of footway, towpath, and canal trunk, thickness	3
Weather boarding,	N	"	¾
Iron suspending rods,	R		1½diam

Screw bolts, 1 inch square; spikes for planking of canal trunk, ¼ inch square; spikes at heads and feet of braces, ¾ inch square.

In figure 1 it will be seen that the tops of the lower girders are not all in the same horizontal line, but that every other one, H, is raised about one foot above the intermediate ones, G. When the aqueduct was first built, only one of these sets of girders was employed, being supposed sufficient to sustain the weight of water in the trunk. Their distance apart was about ten feet in the clear. But when the water was let into the trunk, the girders began to yield under a head of about three feet, and it was found necessary to double their number, and moreover to bolt, or rather stirrup, to every alternate one, viz: those marked G, an additional under-girder, A, fig. 2, 3, 4.

The reason for thus alternately raising and depressing these lower girders was, to permit the passage of the two courses of lower diagonal braces from one H to another, over G, (see fig. 9, and also the dotted lines *a*, *a*, *a*, in fig. 3.) Where the H's cross the inner chords, (which are lower than the outer ones,) they are made to bear on them, by means of the blocks *h*, *h*, fig. 3. These blocks are not shown in the transverse section, it being supposed to be taken near one of the girders, G. Over the girders, G, are seen (fig. 3,) blocks O, O, marked in dotted lines; there are transverse timbers, resting on G, and helping to support the flooring plank of the canal trunk, as there are no longitudinal joists in the aqueduct. The pieces O, do not interfere with the diagonal braces, merely running from each inner chord to the braces.

The floor of the trunk rests only on the upper course of diagonal braces, on the transverse pieces, O, and on the raised girders, H.

Each girder, H, and G, is sustained by the two inner chords, and by four suspending rods of iron, one and a half inches in diameter, of which two are shown in fig. 4, by R, R. In the outer trusses, the tops of these rods bear on the tops of the arches, or curved ribs, (see fig. 1,) by means of wooden saddle pieces, D, figs. 3, 4. In the inner trusses, they bear upon the tops of the poles, or caps, and are covered by a longitudinal capping piece, of 3 inches thickness, (*m*, fig. 4:) this capping is rounded off at top, so as to prevent the chafing of the tow-rope.

To bring the bearing of the suspending rods more equally on all the arch-pieces, blocks are inserted between the arch-pieces, vertically, at the place of each rod, as shown in fig. 3. M, M, in fig. 1, are extra braces, employed only in the outer trusses; *k*, *k*, are their straining-sills. At their upper ends they abut against short pieces of 6 × 12 (*f*, *f*,) firmly bolted to the poles. These extra braces are in pairs, being on both sides of the poles.

j, *j*, fig. 1, are the straining sills for the pier braces, S, S, serving to stiffen the pier posts; see fig. 6, which also shows the cast iron abutment plates, *g*, *g*, for receiving the feet of the curved ribs. They are merely flat plates, three feet eight inches deep, two feet wide, two inches thick, and without any flanches. The recess in the pieces, for receiving the feet of the ribs, and pier posts, is but eight inches deep. See also fig. 2.

P, figs. 3, 4, are the short butting-pieces for relieving the heads of the queen posts from the action of the main braces. In the inner trusses, instead of these short butting-pieces, long straining-pieces, reaching from one post to another, are used, T, figs. 3, 4. T is represented in fig. 3, to save the trouble of another engraving.

The suspending rods are about five feet apart; but it is seen in fig. 1 that these rods stop short within some fifteen feet of the piers, because the curve of the ribs in that interval would not allow of the passage of girders past them. In this interval, therefore, the ends of the girders are supported by pieces, K, fig. 7, bolted to the ribs.

s, *s*, figs. 2 and 4, are uprights, placed four feet apart, for spiking the side planking of the canal trunk to; at their heads they tenon into a continuous cap-piece, *v*, and at their feet they tenon between the strings *e* and *n*. *n*, and the blocks *t*, being supported by the queens, prevent *s* from spreading outwards.

Where the curve of the arches comes below the line of *t*, the latter is dispensed with, and *v* rests against the arches themselves.

r, *r*, are two pieces, of 3 × 6 inches, spiked to the queens, for receiving the floor plank of the tow-path, on one side, and of the footway for ordinary purposes, on the other.

The roof is boarded and shingled.

Where the tops of the inner arches get below the line of the tow-path floor, a piece of plank, on edge, resting on the floor, is nailed against the queens, to prevent horses from slipping into the canal trunk.

Fig. 5 shows an excellent device for counteracting, to some extent, the tendency which trusses always have to settle in the centre. The poles, or caps of the adjoining arches, are here connected by fishing splices, each composed of two pieces of 4 × 12, well bolted, and tree-nailed together, through the caps; and as a further security, two blocks, *z*, *z*, of hard wood, about four inches square, are driven through, from side to side. By the introduction of these splices, it is obvious that the inward draw of two adjoining trusses is mutually counteracted to a considerable extent. This arrangement, together with the extra braces, serves very much to stiffen the trusses; and something of the kind should always be resorted to in large spans.

Fig. 8 shows the mode of scarfing the pieces composing the curved ribs. These pieces break joint where the ribs pass the queens, so that the bolts of the scarfs pass entirely through the queens, and the rib pieces on each side of them. The scarf of the poles is shown in fig. 3; that of the chords is the same as that of the poles, only that which constitutes the side view of the pole scarf, forms the top, or plan, of that of the chord.

Fig. 11. As it is always a matter of importance in a bridge erected over a stream liable to freshets, to secure each span as soon as possible, so as to stand in case the scaffold should happen to be carried away; the introduction of the secondary timbers is generally deferred until those essential to the support of the bridge, in such an event, are put together. Therefore, the diagonal braces are not inserted until after the girders are put into their places.

As these braces are tenoned into the girders at both ends, they could not be inserted into the mortises in the girders, unless some *play* were allowed at one end; this play is afterwards filled up by a pair of double wedges, as shown in fig. 11.

Where the counterbraces of the trusses intersect the main braces, the former are merely tenoned into the latter, as shown in fig. 3, at Y. Where the chords and queens intersect, they are notched equally into each other, so as to bring the two pieces composing the chords within about an inch of each other, figs. 2 and 4.

The planking of the canal trunk is single, and well caulked. The courses of plank are from six to fifteen inches wide.

Remarks.—This aqueduct evinces, more strikingly than any other structure I know of, the capability of timber for the purpose of bridge building. The weight of water in the canal trunk on a single span, when four feet three inches deep, amounts to 275 tons, of 2240 lbs.; and we may safely say that that weight is frequently increased to at least 300 tons, during the passage of boats; for although a boat, of course, displaces a bulk of water of equal weight with herself, yet it may readily be conceived that the water so displaced does not instantaneously leave the span, on her entrance; and I think we may assume that at least twenty-five tons of it are frequently on a span at the same moment with the boat. Yet on a most critical examination, made with that view, I could not detect in any part of the timbers the slightest symptom of what might with propriety be called *crushing*. Slight *compressions*, (if I may be allowed to draw such a distinction,) were visible at the heads of the queen-posts, but not to a greater extent, apparently, than invariably attends all trusses of this kind in common bridges of large spans, after having been some time in use. In all bridges there is a tendency to settle, or sag, in the centre; and this tendency, of course, brings a heavy compressing strain upon the pole plates; but beside *this* compression, incident to the truss considered *as a whole*, there is *another*, acting at the several points at which the heads of the posts tenon into the poles. This compound compression explains a fact for which I was for some time at a loss to assign a satisfactory reason. I have already stated that in the *inner* trusses of this aqueduct, a straining-piece, like that shown at T, fig. 3, was inserted between the heads of the posts, in preference to the short butting piece, P, figs. 3, 5, employed in the outer trusses. This was evidently done under the impression that it opposed a more perfect resistance to the compressions alluded to, than the shorter pieces; and, at first sight, it will probably strike most of my readers in the same manner. But it is of great importance to know, that although the long piece is almost invariably introduced, both by engineers and bridge builders, whenever extraordinary compression of the pole is anticipated, it is in fact *entirely ineffective:* whereas the short butting pieces perform the duty assigned them perfectly.

I shall endeavor to point out the cause of this.

The compression of the poles evidently increases from the piers towards the centre of the span, in the same manner as in a single long piece of timber, supported at two ends, when it sags in the middle: consequently, when the bridge settles, as it always will, more or less, the head of any one post is moved a greater distance towards the centre of the span than the post behind it, that is, between it and a pier. Therefore, the opening, p', behind the post, Q', must be a little wider than the opening p, behind the post Q; and, consequently, the inner end of the straining-piece, T, cannot be forced up into contact with the head of the post Q, but must remain distant from it an amount equal to the difference of the compression which takes place in that part of the pole between Q' and the centre of the span, and that part which extends from p' to p. This difference in the amount of compression between any two consecutive posts, is very perceptible in all large bridges, being generally about one-eighth of an inch, that is if there be seven spaces in the truss, between a pier and a king post, the opening at the inner one will generally be about seven-eighths of an inch, at the next one six-eighths, at the next five-eighths, and so on to the queen post near the pier, where it will diminish to nothing. In some bridges, and those excellent ones, I have seen the openings behind the queen posts much greater than this, at least double; but, I believe, only in such bridges as have no chords to confine the feet of the ribs. Of course some portion of these openings, in every case, is due to the compression which takes place in the heads of the posts themselves. This is frequently very perceptible. I could just detect it in a few of the queen posts of the aqueduct.

But it may be objected that if the explanation I have given be correct, then even the short butting piece, P, should also be ineffective; because, if the compression of the pole increases so perceptibly towards the centre, then supposing the length of the butting-piece to be one-fourth of the distance between two queens, the inner end of the butting-piece should not come into contact with the pole, by an amount equal to one-fourth of the opening which occurs between those two queens. Plausible as this deduction would seem, it is, nevertheless, incorrect, for as I have before remarked, the short butting-pieces act admirably, and, as I conceive, for this reason, that although the entire length of that portion of a pole, or cap, between two adjacent posts, is in a state of compression, which, considering the whole truss as one great beam, gradually increases towards the centre. Still the action of the main braces against the back part of the head of each post, tends to bring an additional strain upon the portion of the pole next adjoining the *inside* of the post head. This additional strain produces a compression of its own, which, unlike that operating on the truss considered as a whole, *decreases* towards the centre. Therefore, that part of the pole into which the head of any post tenons, is more compressed than the part at the end of the butting-piece, and, consequently, the latter is brought into full action.

This matter is a very important one, and my remarks on it were suggested by seeing that in this aqueduct the long straining-piece had superseded the short butting-piece, evidently in expectation of its greater efficiency. In the Market street bridge, at Philadelphia, the finest in existence, the same defect exists; also in the viaduct of the Columbia and Philadelphia Railroad, near Philadelphia, and many others, built by the most talented and experienced bridge builders in the country.

But in all these bridges, as well as in this aqueduct, the inner ends of none of these long straining-pieces are in contact with the heads of the adjoining posts, against which they were intended to exert a powerful compression. Consequently, they are not only useless, but positively injurious, as they add unnecessarily to the weight of the truss, and thus absolutely *increase* that tendency to settle, which they are intended to prevent.

I noticed a splintering, or spalling off, of the stones supporting the feet of some of the arches. The stones in this part of a bridge, as well as those forming the facing of the starlings, should always be of good quality; and, in the former case especially, attention should be paid to their *toughness;* soft sandstone should never be admitted.

In an extreme case like this, of such an immense weight and so soft a stone, or indeed with stone of the best quality, I should certainly prefer to have the recesses in the top of the pier for receiving the feet of the curved ribs and pier posts, somewhat deeper than in this instance, where they are but eight inches deep, figs. 1, 2, and 6. The pressure on the piers and abutments, so long as the bridge maintains itself, is almost altogether vertical, and as it sometimes happens that the bearing is not very fair, every precaution should be used to prevent spalling. One of the spans, at the time I saw the aqueduct, was (in my opinion,) in imminent danger of falling, in consequence of this.

I am confident that two trusses, instead of four, would have been sufficient to support the trunk of this aqueduct, especially if another arch-piece had been added to the depth of the curved ribs, and the height of the trusses made a little greater. This additional height would, moreover, have added to the convenience of passengers on the roofs of the boats, who are now obliged to stoop in passing through the aqueduct. As the use of but two trusses would, of course, increase the clear width between them, to admit the tow-path, the girders might be trussed by a heavy arch-piece, which would insure abundant strength. A considerable diminution of expense would attend such an arrangement.

As to the piers of this aqueduct, they are, as before stated, *but seven feet thick on top*, or $\frac{1}{21.43}$ part of the span; or not quite *one-half as great* as the proportion of those used in the Trenton bridge, which is the boldest one cited by Tredgold, in his table of stone piers for wooden bridges.

I am by no means prepared to advocate the *breakwater* starling, (so called,) used in this aqueduct, and in many large bridges in the country. I have known them to pitch very heavy blocks of ice upon the roof, and outside footways of the bridges to which they were attached. This never occurs with semi-circular starlings, and as I have never known one of the latter shape to be injured when built with care, I consider it preferable to the other—though I think something like a semi-ellipse still better. My own practice is to batter the fronts of the starlings two inches to a foot, and work them into one inch to a foot, as they approach the sides of the piers. Experience has given me every reason to be satisfied with this shape. In very exposed situations, there would be no objection to increasing the front batter to considerably more than two inches to a foot.

The foundations of the piers of the aqueduct do not appear to have settled in the least, or to have undergone any derangement; still, even in the face of this precedent, I should certainly prefer the foundation to be laid at the depth of a few feet below the bottom, in structures so important as this. There are, however, several bridges across the Alleghany, in the vicinity of the aqueduct, and all their piers are founded in this manner, (some of them, indeed, having but one course of timbers in their platforms,) which is strong evidence of the sufficiency of the plan, on a gravel bottom, even when exposed to tremendous freshets.

Viewed as a whole, this aqueduct, for which, I am under the impression, there was no precedent, certainly reflects the highest credit

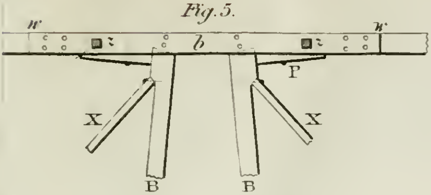


Fig. 5.

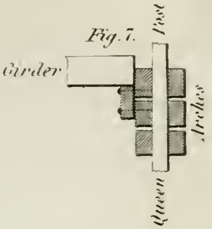


Fig. 7.

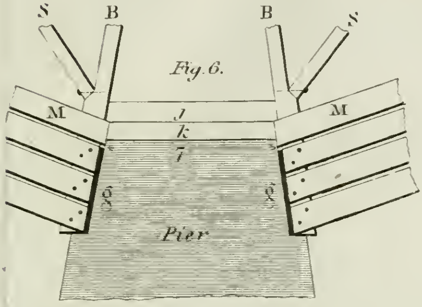


Fig. 6.

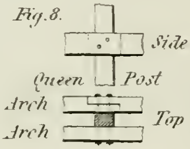


Fig. 8.

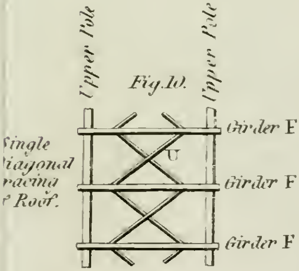


Fig. 10.

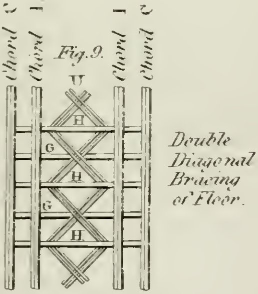


Fig. 9.

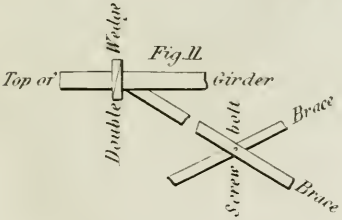
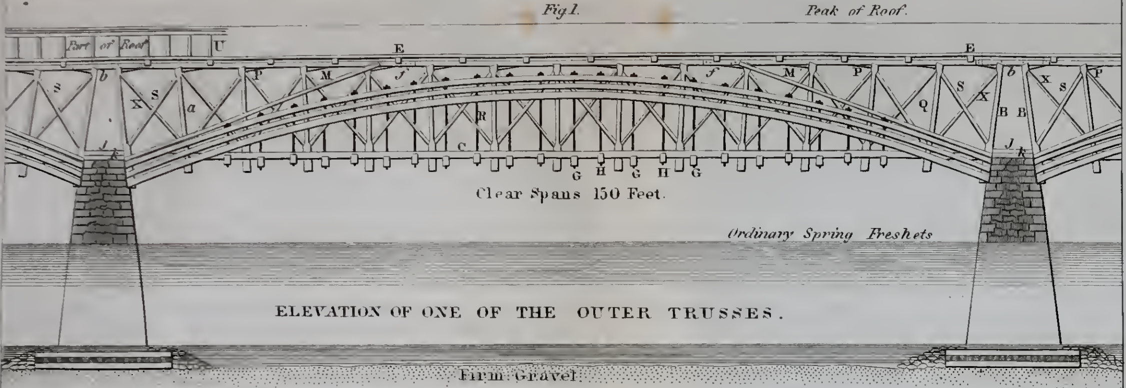


Fig. 11.

Fig. 1.



ELEVATION OF ONE OF THE OUTER TRUSSES.

Scale for Fig. 1.

0 10 20 30 40 50 Ft.

0 10 15 20 25 Ft.

Scale for Fig. 2.

Fig. 4

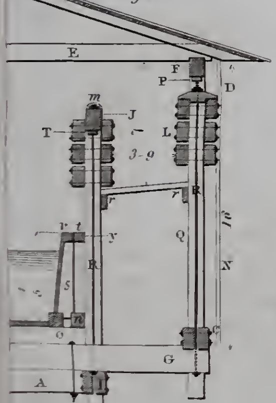
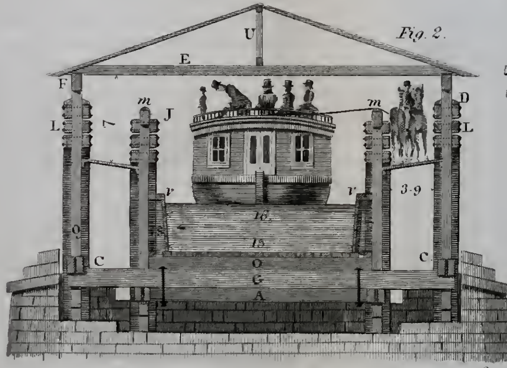
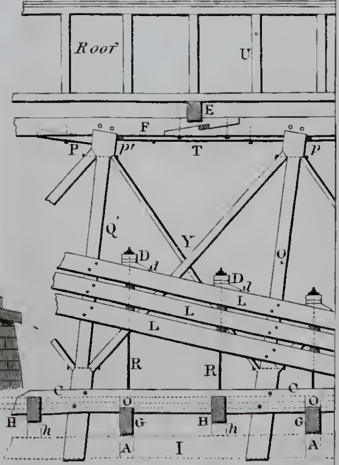


Fig. 2.



TRANSVERSE SECTION OF AQUEDUCT,
Taken at centre of a Span.

Fig. 3.



0 10 15 20 25

Scale for Figs 3, 4, 5, 6.

Fig. 5.

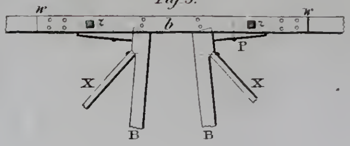
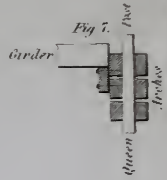


Fig. 7.



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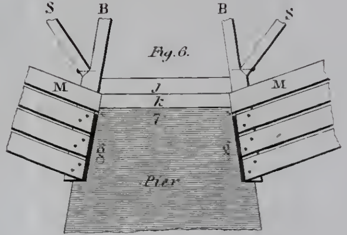


Fig. 8.

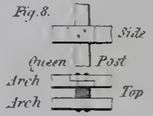
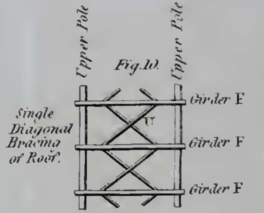


Fig. 10.



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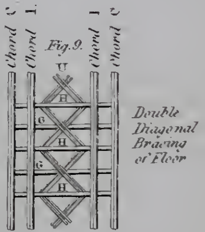

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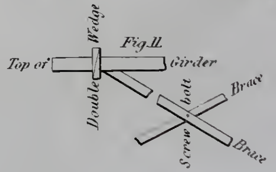

on Mr. Lothrop, for boldness and mechanical skill.* There are others, of much the same kind, on the canal; all, I believe, designed by him. The general arrangement of the timbers is not original with him, having been long before practised, in very many instances, in common bridges; but the application of it to the purposes of so extensive an aqueduct, was certainly a very bold step; and its entire success is proof of an intimate knowledge of what he undertook.

I look upon this arrangement of timbers as the best yet devised for large spans. It certainly admits of many improvements in its details, and from some experiments of my own on the subject, I am under the impression that considerable modifications in some of the more important parts, might be made with advantage. I may take occasion, in some future paper, to allude to them.

The curved rib, it is well known, *is stronger* in the centre than at any other point; or, in other words, a load, which, applied between the centre and one of the piers, would destroy the rib, might be supported, with perfect safety, in its centre. But the truss which is connected with the ribs, *is weaker* in the centre than at any other point; its resistance to a load acting at any point, being, as in the case of a single piece of timber, proportional to the rectangle of the distances from the point at which the load is applied to the points of support. *Therefore, the combination of the curved rib with the truss, secures a more uniform degree of strength throughout the whole span, than could be attained by either one, used separutely.*

But besides this, another very important consideration attends the combination of the curved rib with the truss, viz: that each not only contributes its own share to the support of the load, but actually *increases the power of resistance of the other*—that is, the two combined will support a greater load than they could separately, were the load divided between them. A curved rib, when employed by itself, is very weak at the haunches, and readily yields to a load applied there; but if proper means be adopted for preventing the rib from *changing its form*, its strength is wonderfully increased, indeed to such an extent that actual crushing of the timber must take place before the rib will yield to its load. Without this precaution, its flexibility will permit it to bend, and fall through between its abutments, under a load many times less than that necessary to *crush* it. *Such a change of form, or bending, is prevented by the truss*, and thereby so great an accession of strength is imparted to the rib, that if we could conceive of the truss acting only in this capacity of a stiffener to the rib, without itself sustaining any portion of the load, still the strength of the bridge would be increased many fold. I have seen curved ribs of 200 feet span, bend, and fall into the river, between their abutments.

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* We think it proper to remark here, that in the sixth volume of the London Repertory of Arts, p. 220, is detailed at length, the specification of a patent taken out in England, in 1796, by Mr. James Jordan, *for constructing aqueducts and bridges, with curved ribs of timber, or iron, and suspending therefrom, by iron rods, the floor or trunk, as the case may be.* The celebrated bridge over the Delaware, at Trenton, commenced in 1804, is, in its general outline, almost a precise copy of the plate illustrating Jordan's patent, in the Repertory of Arts, and is, in principle, unquestionably, *an infringement of that patent.* Mr. Jordan also gives a plate of a projected aqueduct, precisely the same in its essential principles as that which forms the subject of the above paper. Com. Pub.

The highest known freshet of the Alleghany, rose to about the floor line of the canal trunk; the weather boarding of the outside formed a kind of dam, against which, trees, barns, houses, &c., accumulated, until they formed a wide field of drift on its upper side. A large concourse of people stood on the banks of the river, expecting to see the whole structure lifted off from its piers, and floated away; but it stood perfectly firm, and I believe sustained no injury whatever.

It is my intention to endeavor, through the medium of the Journal, to supply, in some measure, a deficiency that exists in all our works on carpentry, in that department which treats of the spanning of large openings. The best mode of doing this will, probably, be to present to the reader a series of papers, descriptive of existing structures, with such comments as may happen at the time of writing, to be suggested by the particular example under consideration. This paper may be looked upon as the first of the series, and I shall endeavor to follow it up, as my leisure permits, by other interesting examples of such works as have come under my own immediate notice. In some future paper I shall enlarge more fully upon the several individual timbers composing such a truss as that employed in this aqueduct. The subject of wooden bridges, of large spans, is a very interesting and important one, and one of considerable intricacy. Its importance has of late been much enhanced, by the discoveries of preservatives of timber from decay. Should an equally effective preservative against fire be discovered, which, under the present rapidly increasing discoveries in chemistry, is not at all improbable, we should have much less reason than at present to regret our national want of fine stone bridges.

Athens, Tennessee, May, 1843.

Mode of Tracing a Curve of very large Radius, adopted in the Survey of the Northern Boundary of the State of Delaware, in 1701.

Professor John F. Frazer has deposited at the Hall of the Franklin Institute, in Philadelphia, some interesting documents, concerning the original demarcation of the curvilinear boundary, dividing the northern part of the State of Delaware from the conterminous States of Pennsylvania and Maryland. These documents consist,

I. Of the original warrant by William Penn as "Proprietary and Governor of Pennsylvania and the counties annexed;" bearing date the 28th day of the 8th month, 1701, and directed to Isaac Taylor, of the county of Chester, in the province of Pennsylvania, and Thomas Pierson, of the county of Newcastle, "*in the territories;*" instructing them to accompany the magistrates of each county, or any three of them, within the space of forty days after date, and in their presence to admeasure, and survey, a circular boundary line, struck by *a radius of twelve miles,* from the town of New Castle, as a centre; the line to be well marked, and to consist of "*two-thirds of a semi-circle of twelve miles radius.*"

II. Of a duplicate record of the official proceedings of the appointed surveyors, and the field notes of the survey, made pursuant to the aforesaid warrant, in the presence of six magistrates—three of the province of Pennsylvania, and three of the "*annexed territories,*" now the state of Delaware.

By this document it appears that the centre of the arc of the circle, or the point of beginning the radial line, was established by the magistrates "at the end of the horse dike next to the town of New Castle," thence by various courses, *rectified to a due north line,* the surveyors ran off *the radius of twelve miles,* terminating at a white oak tree, in a sinuosity of the Brandywine Creek; and as it will probably be more interesting, we subjoin an extract from the official memoir, in which the surveyors (in their own language,) give a brief account of their operations, in first tracing a radius of twelve miles, *due north,* and then marking out the required segment of 120°, by uniform angles of deflection from primary chords, *as is at this day practised* upon railroads, and similar works.

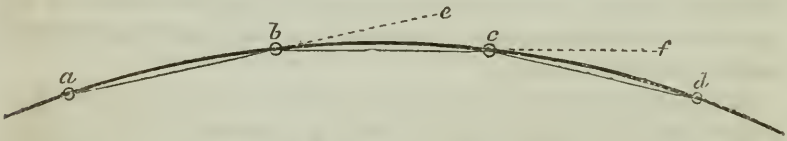
Extract from the Surveyor's Memoir.

"The 26th day of the 9th month we did begin, in the presence of the said justices (Cornelius Empson, Richard Halliwell, John Richardson, Caleb Pusey, Philip Roman, and Robert Pyle, Esquires,) at the end of the horse dike, and measured due north twelve miles, to a white oak, marked with twelve notches, standing on the west side of

Brandywine Creek, in the land of Samuel Helm; and from the said white oak we ran eastward, circularly, changing our course from the east southward, one degree at the end of every sixty-seven perches, *which is the chord of one degree to a twelve miles radius;* and at the end of forty-three chords we came to the Delaware river, on the upper side of Nathaniel Sampley's old house, at Chichester; and then we returned to the said white oak in Israel Helm's land, and from thence we ran westward, changing our course one degree from the west southward, at the end of every sixty-seven perches, as before, until we had extended seventy-seven chords, (which being added to the forty-three chords, make two-third parts of the semi-circle to a twelve mile radius,) all which said circular line being well marked with three notches on each side of the trees, to a marked hickory, standing near the western branch of Christiana Creek. Surveyed the 4th day of the 10th month, 1701, by us."

(Signed) Isaac Taylor,
Thos. Pierson.

To elucidate more fully the principles involved in this demarcation, we subjoin a diagram (on a scale necessarily distorted,) showing three of the chords assumed at random from the eastern part of the survey.



Uniform length of each chord = nat. sin. $\frac{1}{2}°$ × 12 miles, rad. × 2 or .008726 × 3840 perches × 2 = 67.01952 perches, *say* 67 *pers.*, which is the chord of 1° of a circular arc, of the radius fixed; as is correctly stated in the surveyors' memoir.

$$\text{Chords,}\quad \left\{\begin{array}{l} a\,b = \text{S. } 79° \text{ E. 67 pers.} \\ b\,c = \text{S. } 78° \text{ E. do.} \\ c\,d = \text{S. } 77° \text{ E. do.} \end{array}\right\} \quad \begin{array}{c} \text{Angles of deflection,} \\ e\,b\,c,\ f\,c\,d, \text{ \&c.} \\ \text{uniformly } 1°. \end{array}$$

The surveyors began their field labors on the 26th day of the 9th month, 1701, and closed them on the 4th day of the 10th month, having occupied but nine days in the work; running, within that time, twelve miles of radius, and twenty-five and one-eighth miles of chords of the curve—in all upwards of thirty-seven miles, or more than four miles surveyed and measured each day, at an average.

When we consider the care required in tracing the chords by rectified courses, and the obstacles which the face of the country must then have presented, *this was rapid work;* and it stands forth in striking contrast to the vast length of time, which similar geodesic operations are at this day made to consume.

It will be obvious to all who are conversant with matters of this nature, that the mode adopted in 1701, by these surveyors, *in tracing this arc of twenty-five miles long*, upon a radius of twelve miles, *is in substance the same* as that so generally used at the present time in marking out upon the ground the large circular curves of railroads, in which—as in the case of this boundary line—the centres are at an inconvenient distance.

The main principle involved is, *that of deflecting a constant angle in passing from one chord to another of equal length;* by which process a number of points in a circular arc may be correctly established, by the salient angles of the inscribed polygon, as is easily shown from the geometry of curves.

In railroad surveys the primary chord is usually assumed at the fixed length of one hundred feet for all curves, (instead of sixty-seven perches, as adopted in this case, to make the uniform angle of deflection 1°;) and the angle of deflection between the chords is, for any given curve, made proportional to its radius, as must necessarily be the case when the chord employed is of a constant length: still the principle involved, as well as the mode of operating with the circumferentor, is precisely the same in marking out a railway curve, as was employed by Messrs. Taylor and Pierson, in the trace of the circular boundary line above described, and which is highly creditable to them, as a practical operation, performed with the most simple instruments.

The idea has been generally entertained that Lieut. Col. Long, of the United States Corps of Engineers, was amongst the first to deduce from the geometry of curves, and to apply, practically, the mode of tracing circular arcs of large radius, to which we have just referred; and in a little work published in Baltimore, in 1829, entitled the *Railroad Manual*, which has become amongst engineers a text book of curvature; Col. Long developed in a very perspicuous manner, all the principles necessary to the demarcation of great curves, by means of primary chords of one hundred feet; as well as to enable the inscription within the primary arcs, of a decimal system of sub-chords; but from what we have said above, it would appear that in the main features of the process he had been anticipated, as long ago as the year 1701, by Messrs. Taylor and Pierson, the surveyors of the circular boundary line of Delaware.

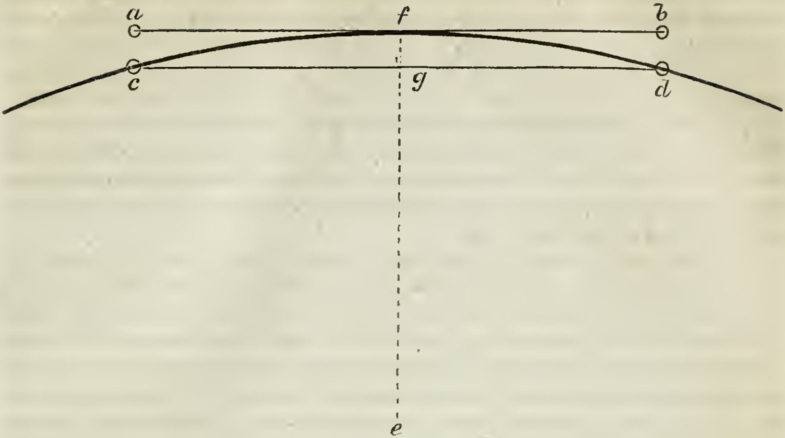
Before closing this subject, we must remark that, although the boundary surveyors clearly developed the plan of tracing a large arc of a circle, *by constant angles of deflection between primary chords of equal length*, so as to be geometrically correct; nevertheless it is singular that, in applying these principles upon the ground, they have committed an error, in consequence of having laid the line intended for the first chord, *in the position of a tangent to the arc.* It appears from the field notes, that after having run off north from the town of New Castle a meridian line, as radius, the surveyors determined that the first chord of their circular arc should bear east and west, and, therefore, be *bisected* by the meridian radius; now it is perfectly evident that any chord of a circular arc, *bisected by a radius,* must cut that radius at a distance back from its extremity, equal to the versed sine corresponding to the given chord; therefore, in the case before us, the surveyors ought to have set back towards New Castle, from the extremity of the meridian radius of twelve miles, the proper length of the versed sine, or, nat. vers. sin. $\frac{1}{2}°$ × 12 miles radius $= .0000381 \times 3840$ perches $= .1463040$ perches, or 2.414 feet; and from the correct point of concourse of the radius and chord determined thus, they should then have laid off from the meridian the courses and distances recorded in their field notes, viz: East 33½ perches, and West 33½ perches—in all 67 perches, the calculated length of the chord. This process would have correctly fixed the position of the chord, and, from its eastern and western extremities, the courses and distances of the field notes being run off, *an inscribed polygon* would have been correctly formed about "the end of the horse dike" at New Castle, as a centre.

But from the field notes it would appear that the right line designed for the first chord of sixty-seven perches, was laid off equally east and west, *from the extremity of the meridian radius;* it therefore occupies a false position, as regards a segment of a circle of twelve miles radius, described "*from the end of the horse dike*"—in fact, it is tangent to such an arc—but, nevertheless, in connexion with each other, the whole 120 chords run by the surveyors, do actually form sides of a polygon inscribed within a circle of twelve miles radius, *but relating to a centre, distant from the intended one, due north, the length of the versed sine, corresponding to the chord of one degree of the arc.* In consequence of the great length of the radius, this distance is fortunately of but little practical importance, being but 2.414 feet, as we have shown above; so that the real centre of the circular boundary line actually traced, is nearly two and a half feet distant from that which was established by the assembled magistrates.

The annexed diagram (on a scale distorted, of course,) will convey more clearly to the eye, the error we have attempted to point out.

a, b, = The east and west line, of sixty-seven perches, traced by the surveyors, in lieu of the proper chord, *c, d.*

e, f, = A portion of the meridian radius of twelve miles, run due north from "*the end of the horse dike.*"



f, g, = The versed sine corresponding to a chord subtending one degree of such an arc = 2.414 feet, which is of course the distance *due north,* which the centre of the circular segment was *in effect* removed by the error which appears to have been committed by the surveyors. M.

Facts and Observations on Four and Six Wheel Engines. *

By John Herapath, Esq.

[CONTINUED FROM VOL. III, PAGE 391.]

Midland Counties Railway.

This line, as the public knows, unites Nottingham with Derby, and both with the London and Birmingham at Rugby. The length between Derby and Nottingham is 15½ miles; between Derby and Rugby 49⅓ miles; and between Nottingham and Rugby 47¾ miles. The total length of line worked is 57½ miles.

Here I have had an opportunity of seeing stone blocks, cross sleepers, and longitudinal bearings, mixed and intermixed in such a manner as to make a strong and decisive impression upon me of their relative advantages, of which I shall speak hereafter.

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* The subject matter of these interesting papers—which we are engaged in re-publishing from the Railway Magazine—acquires renewed interest, from the occurrence of the late shocking accident upon the Paris and Versailles Railway, in France.

In this fearful catastrophe, it appears, from the newspaper accounts, that the passenger train was drawn by two engines, as in the case of the accident on the London and Brighton Railway, which we noticed at page 243 of the last volume; and, *as in that instance,* the auxiliary, or leading, engine, was *a four wheeled machine,* whilst the other ran on *six wheels.*

So also in the former, as in the latter case, *the four wheeled engine* was the first to fly the track; the second followed, and the destruction of carriages, and consequent loss of life, was terribly aggravated, by the fact that *at the same time* the train was also *impelled forward* from behind, by *a third engine,* attached for that purpose, which, partaking of the high velocity of the whole train, the moment the stoppage took place in front, drove forward, over the ruins of the rest, some of the rearward cars, which might otherwise have been saved with their passengers, and probably without injury. Com. Pub.

The great blot upon this line is a curve of only 11 chains radius, crossing the Derwent, and entering the station at Derby. Being at a terminus, it can be productive of no danger, but in the perpetual strain which it impresses on the engines while traversing it, and the play which they are obliged to have upon the rails and axles to compass it, are, in my opinion, great sources of expense in the wear and tear of the engines, and, also, upon all the rest of the road; for whereever great play is upon the rails, and in the axles, a strong sinuous motion is the consequence, and, naturally, an excess of wear and tear, both of the engines and road.

The Midland Counties' Company's stock consists of 29 passenger, and 6 merchandize, engines—28 of the former having four wheels and inside bearings, and one four wheel with outside bearings, and cylinders outside these bearings. Of the merchandize engines, four have four wheels and inside bearings, one outside bearings and six wheels, and one with outside bearings, outside cylinders, and six wheels. The four wheel passenger engines weigh from 11 to 12¼ tons each; the four wheel merchandize, 12 tons 6 cwt.; and the six wheel, nearly 15 tons. The proportion of weight on the leading and driving wheels of the lighter passenger engines, is as 3½ to 5¼, and on the heavier, as 4 to 5¾; on the merchandize, as 4 to 5½. Four of these four wheel engines are coupled, and they are described as working pleasantly, safely, and economically. One of six wheel has flanches, "and is done without."

Of these 35 engines, 29 are now (December) ready to take a train.

But very few detentions of trains are represented to have taken place, and these not from derangement of machinery, but now and then cases have occurred of detentions from the bursting of boiler-tubes. There have been no failures from broken crank axles, and only in one case has an engine run off the line, and that was from the embankment having subsided a foot during the night, and a dense fog having in the morning prevented the engine driver of the first train from seeing the state of the road. This was with a four wheel uncoupled engine.

The first cost of engines of this company is from £1,250 to £1,400.

In answer to the question of what his experience tells him is the advantage of four or six wheel engines, one over the other, Mr. Kearsley replies, "both have advantages under different circumstances." I could have wished he had been more explicit, as from his experience with both kinds, his opinions merit attention. This gentleman says they have no top-heavy engines, and very little motion in any of them, except a little sinuous, owing to the play which they feel it necessary to give the leading wheels in the axles to combat the curves with. These sinuous motions, he observes, are nearly the same in all parts of the line, the Derby curve, I presume, excepted.

The average consumption of coke is from 25 lbs. to 35 lbs. per mile for passenger trains, and from 40 lbs. to 50 lbs. for merchandize trains. From some oversight, I suppose, he has not given me the gross loads taken with either train.

I believe, not one of their engines works expansively.

Mr. Kearsley is of opinion, that the nearer the cranks are to the principal axis of the engine, the steadier the engine works. The current locomotive expense of repairs, per mile, according to the last two months' returns, is 13½d.

On Wednesday and Thursday, Dec. 8th and 9th, I had opportunities of riding on seven of this company's engines—the *Vulture, Lynx, Sultan, Centaur, Bee, Hercules,* and *Unicorn;* all of which, except the *Hercules,* were four wheel engines.

The principal motions I observed in these engines were the sinuous, and these were obviously owing to the great play the engines had to prevent too great strain in turning the curve at Derby. The *Vulture* was an extremely lively engine, but too short in the springs, which made her rough to ride on. The *Lynx* was an easier engine to the rider. The *Sultan* was evidently a strong and powerful engine, but inferior in steadiness to the *Centaur.* The *Bee,* the engine to which Hall's smoke-consuming apparatus is applied, is a little four wheel engine, only five feet distance between the axles, with outside framing, and cylinders outside the framing. By some means she has a sad character for endeavoring to turn her tail where her head ought to be, while running on the rails. However, in spite of this character, I accepted the offer of a ride upon her from Nottingham to Derby. There was a strong wind on our right, and we came along at a rapid rate for a little engine like the *Bee;* I should think, at some times, full 45 miles an hour. With such a wind and speed, and nothing but a slender rail to hold by, I had some difficulty, in the most exposed situation on the engine, to keep my place, and certainly had no small portion of my attention directed to the means of preventing myself from being blown off. However, from the attention I could spare, I did not perceive any of that dangerous tail-turning which I had heard of, nor any of that lateral wriggle I had noticed with outside cylinders, both on the Birmingham and Gloucester, and North Union, Railways. She had much sinuous motion, but appeared to me to have no other of any consequence, and so I told Mr. Kearsley when I arrived at Derby. Indeed, I thought I had here found an exception to the rule I had observed with all those engines having outside cylinders which I had rode on, namely, a lateral, or side, wriggle, or vibration, keeping time with the beats of the piston. In a letter, however, which I have since received from Mr. Kearsley, he mentions a subsequent trial with her, undertaken at my request, that considerably shakes my opinion. As he intends another trial, I forbear to say more of it at present.

The last engine, the *Bee,* and another, the *Hercules,* a six wheel engine, with outside framing and outside cylinders, and driving-wheels in the middle, were very kindly put on to special trains of goods by Mr. Kearsley, in consequence of the publication of my disappointment on the Grand Junction line with the *Œolus,* and such valuable opportunities they afforded, that I felt thankful to the parties of the Grand Junction for the disappointment.

Upon the *Hercules* I rode from Derby to Leicester, and though, probably, she was a good engine, both Mr. Kearsley and myself could not help noticing her sluggish heavy movements in comparison with the nimble and agile motions of the previous four wheel engines. The contrast to me appeared very much like that of a heavy cart-horse to a blood-horse, and the same has been always my experience. Somehow or other, the four wheel engines trip off with their loads as if to take them was no effort, while the six wheel labour like animals over-encumbered with their own weight.

The *Hercules* had very sensible longitudinal motion when the velocity approached 25 or 30 miles an hour, and a considerable degree of lateral wriggle, which by leaning against the side rails and watching the eccentrics, Mr. Kearsley and myself observed kept time as nearly as we could determine, with the beats of the pistons.

While traveling upon this engine, I walked several times along the platform by her side, to her very front, stopping at various points to observe her motions. On the platform by her fire box, her side wriggle, and other motions, were most sensible; over the driving wheels they were much less so, and over the leading wheels, near where the cylinders were, they were to me imperceptible. The sinuous motion of her front framing, which on the platform appeared very great, when I stood at her head was very insignificant.

From Leicester I rode to Rugby, on the *Unicorn*, a very favorite engine, and deservedly so, of the Secretary, Mr. Bell. She was about the best engine of the company I had been on, most lively and active, but very noisy, from the constant blowing off of steam, which it seemed she generated without limit, as move at whatever rate we chose, she had still a superabundance of it. This engine was not without longitudinal motion, and, I thought, a slight disposition to roll.

The following table of these engines was furnished by Mr. Kearsley.

Particulars of Locomotive Engines inspected by Mr. Herapath.

Name of engine.	Diameter of cylinders.	Length of stroke.	Size of driving wheels.	Size of leading wheels.	Size of trailing wheels.	Total weight of engine.	Weight of fore part.	Weight of after part.	Wt. of leading wheels.	Weight of driving wheels.	Weight on leading wheels.	Weight on driving wheels.	Weight on trailing wheels.	Distance between centres of wheels.
	in.	in.	ft. in.	ft. in	ft. in.	ts. cw.	ts. cw	ts. cw	cw	ts. cw	ts. cw	ts. cw	ts. cw	ft. ins.
Vulture	12	18	5 6	4 0		11 1	4 6	6 15	17	1 9	3 9	5 6		5 6
Lynx	12	18	5 6	4 0		11 1	4 6	6 15	17	1 9	3 9	5 6		5 6
Sultan	13	18	5 6	4 0		12 4	4 17	7 7	18	1 12	3 19	5 15		6 0
Centaur	13	18	5 6	4 0		12 3	4 16	7 7	18	1 12	3 18	5 15		5 9
Bee	11	16	5 0	3 6		9 10	3 12	5 18	15	1 8	2 17	4 10		5 0
Hercules	13	18	5 6	3 9	3 9	14 18					3 18	5 10	1 10	11 0
Unicorn	12	18	5 6	4 0		11 1	4 6	6 15	17	1 9	3 9	5 6		5 6

For the following synopsis, extracted from a letter to me, of Dec. 14, I am indebted to the same gentleman.

"I send you a rough sketch of our line, with the distances, by which you will see we have three independent lines to work, viz:

from Derby to Rugby, 49½ miles; from Derby to Nottingham, 15½ miles; and from Nottingham to the Junction, 7½ miles; which makes it a very difficult line to work, more especially as we have the London and Birmingham at one end, and North Midland and Derby and Birmingham, at the other; and we have to time our trains to suit all three.

"We run about 1,200 miles per day with trains and merchandize, and 500 miles on Sundays. The engines run commonly six weeks, and then stay in a week, except in cases where men have two engines appropriated to them, and, if both are in repair, they run every alternate week—every day in the week 100 miles, and take their turns on Sundays—this is between Derby and Rugby.

"Between Nottingham and Derby, two engines do the work; one runs 93 miles every day, and the other 60 miles every day. They change every week from the longer to the shorter distance.

"One engine in the day does the work between Nottingham and the Junction, running five trips there and back, or 75 miles per day. The driver there has two engines, and runs them alternate days, as the short length and frequent turning I think worse for an engine than running fifty or sixty miles in a length.

"Our goods engines between Derby and Rugby run three days and stay in one, then run three more days, and then in a day, and so on. Two engines came into the hospital yesterday, one having run 30,000 miles, and the other 25,000. Both have come in for new fire-boxes, the original iron boxes having failed, and I am about to substitute copper ones. Had it not been for the failure of the iron fire-boxes, I don't hesitate to say, that the machinery would have run as far again, with trifling repairs occasionally.

"Our bulk of expense in repairs has hitherto been in fire-boxes, nearly all the engines having been originally made with iron boxes, and the deceitfulness, if I may so term it, of that material, has added, I may say, at least 25 per cent. to our repairs. And I expect this will be proved, as I gradually substitute copper fire-boxes."

On this railway I had an opportunity of making some observations, which it may not be amiss here to record. In our travels from Nottingham to Leicester, on Wednesday morning, there having been previously a little rain, I was struck with observing the rails which lay on cross sleepers hold their wet and dampness much longer where the ballast came up to them and was within two or three inches of the top of the edge of the rail; and to part with it much earlier when the ground was hollowed out, and clear of them, to drain the surface. This was not universal, but it was so very general for nearly the whole distance, as obviously to make it, where it was not, the exception to the rule. What may have been the cause, unless it being a mild morning the ballast was much colder than the atmosphere, and communicating that cold to the iron in contact with it, prevented the quick evaporation of the wet, I am unable to explain. Mr. Kearsley, whose attention I called to the phenomenon, at first thought it might be owing to the air having a freer circulation round the rail where the ground was hollowed out, which caused a quicker evaporation; but I was not satisfied with this explanation, and I do not think he was at last, inasmuch as there was little or no current of air, and the appearance was observed in nearly all situations.

The next day we had an opportunity of traveling over stone blocks, cross sleepers, and longitudinal bearings, the two latter in an instructive variety near Rugby. The unpleasant rigidity and harshness over the stone blocks were very sensible, but our attention was chiefly drawn to the comparison of cross sleepers with longitudinal bearings. I had previously mentioned some experience on the Hull and Selby Railway (which I shall hereafter detail,) of the greater draught over longitudinal bearings than over cross sleepers, with which he said his observations agreed, and now we endeavored to appreciate the comparative effects of the two as we traveled along. It appeared to me, and I believe to him, that the train ran much heavier on the longitudinals, which, like traveling over a heavy road, one easily feels; and between the sounds over the two there was no comparison. Over the cross-sleepers the train ran with comparative silence, but over the longitudinals there was a constant heavy murmur and noise. These phenomena of draft and noise happened not in one place, or change, only, but in every one—of which we had a much greater variety than I could have expected to meet with on any line. *To me the observations on this line are satisfactory in favor of cross-sleepers, as to lightness of draught and absence of noise.*

Birmingham and Gloucester Railway.

The American Engines.—I have recorded my experience of these engines, which is, that I was much pleased with their motions at velocities under 20 miles an hour. Since my return from the Great Western Railway, I have received a letter from Captain W. S. Moorsom, the engineer of the line, in which it appears that his experience of these engines, so long ago as the early part of 1840, as nearly as possible coincided with what I have said, page 1074 in the last volume of the *Railway Magazine.** The following is an extract from his certificate, given the 16th of January, 1840:

"The general result in my mind is a conviction that Mr. Norris's engines are admirable machines, particularly for full loads, say 100 tons, at a moderate speed, say 20 miles per hour; and for such occasions I should prefer them to any English engines with which I am acquainted. I have not yet had sufficient experience to judge of their durability, but I should infer from what I have seen, that in this respect, also, they will prove full as durable, and as economical, as any that we have in this country."

With their performances, as to motion under 20 miles an hour, I quite agree with Captain Moorsom. I had no opportunity of witnessing their power, but according to a private document which I have received, detailing some experiments and comparisons of them with one of our best English maker's engines, they fully merit all that the gallant Captain has said of them.

[TO BE CONTINUED.]

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* Jour. Frank. Inst., vol. iii, 3rd series, page 385.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Earle's Process for Preserving Timber.

To the Committee on Publication.

Gentlemen:—In the Journal for last April, page 243, there is, appended to the communication of Mr. Trautwine, a note, which throws doubts on the efficacy and value of the process for the preservation of timber by the sulphates of iron and copper; and "these doubts are chiefly founded upon two facts.

"1. The wooden pavement in this city, in Sixth street, between Chesnut and George—a part of which was prepared by Earle's process prior to being laid—*now exhibits symptoms of decay.*

"2. The recent admirable experiments of M. Boucherie, upon the means of preserving timber, show that whilst corrosive sublimate and pyrolignite of iron effectually protected vegetable pulps from decay, the sulphates of copper and iron (employed by Dr. Earle) were so inert as to retard corruption in but a very trifling degree."

Such is the "note,"—which I have copied at length, that it and the remarks I desire to make on it, may accompany each other.

That there are in "the part prepared by Earle's process" (of the pavement in Sixth street,) as many as six or eight (or, not to diminish the number, say a dozen,) blocks which "*now exhibit symptoms of decay*," is a fact not to be questioned; but those blocks are *single, insulated*, and in no instance, that I can discover, have had *any effect on the integrity of the adjoining blocks*—which, thus far at least, may be considered as of too sound constitution to be infected, or as *non-susceptible.* This is strong confirmation of the opinions expressed by Mr. Wallace and Mr. Thorn, in their (subjoined) certificate, that these imperfect blocks were *originally defective.* The opinion is still more powerfully strengthened by the condition of the remainder of the pavement in Sixth street, which is rotten and rotting from one end to the other—the decay having extended from the first block that gave way to the surrounding blocks—is already in extensive holes, constituting a large proportion of the pavement—the whole of which requires to be renewed. The same, or rather worse, is the condition of the square in Chesnut street, immediately contiguous, from Sixth to Fifth streets. Now, be it noted, that the whole of these pavements (in Sixth and Chesnut streets) were laid (in the summer of 1839) of precisely the *same wood*, and at the *same time.* Chesnut street required repairs in fifteen months after it was laid, has been often repaired since, and is now about to be renewed.

These are facts which lie exposed to the view and investigation of any one interested in them, and are intimately—necessarily—connected with the *inference* to be derived from the admonitory "note," and importantly affecting it.

The quality of the wood, originally, was the *worst.* Of old hemlock, it had, part, if not the whole, been piled some time on the Market Street Railroad, and subsequently on the City Lot, where it was long exposed to all the influences of change of seasons and weather. I had, during a month or two, refused to accept it as the material for the first public essay of my process; but, finding that better was resolutely denied me, and confident in the *principle* of the process, I committed its reputation to this wood, hoping that some subsequent more propitious employment of it might soon occur. The result has been favorable beyond what it was reasonable to hope. That "part" of the pavement has, with the above individual exceptions, maintained its soundness, and already has outgone the anticipations justified by the quality of the wood. How much longer it will last, remains to be seen; but a comparison of it with the adjoining pavements, of the *same wood,* laid at the *same time,* is a demonstration of all I could desire of the process, and suggests the question—if such is its effect on this wood, how much greater may it not reasonably be expected to produce on wood of good quality? The certificate of Mr. Wallace and Mr. Thorn, will give confirmation to what I have stated.

"To correct an erroneous and injurious impression, entertained by many, relative to the wooden pavement in Sixth street, between Chesnut and George streets, we certify, that only a part of it was prepared according to Dr. Earle's process with the sulphates of iron and copper—the remainder being prepared with lime; that the former is still perfectly sound, except six or eight blocks, which, from examination, appear to have been originally defective, (the entire wood of that pavement is of hemlock that had been long kept and was very much injured in its quality;) and that the remainder of it, (prepared with lime,) up to the line where the former ceases, is so far decayed that at this time it almost requires renewal. The contrast between the two portions of that pavement is, in short, of the most obvious and conclusive kind.

T. K. Wallace, *City Commissioner.*
Enoch Thorn, *City Carpenter.*

Philadelphia, April 25, 1842."

To M. Boucherie's "admirable experiments," I will oppose but one of the many facts that might be arrayed against them. It is, at least, as authentic, and by most minds, I believe, will be received as infinitely more conclusive. It is an extract of a letter from James Archbald, Esq., chief engineer of the Delaware and Hudson Canal and Railroad Company; dated "Carbondale, March 21, 1842."

"To your inquiries as to the long continued trial I have been making, of the rope prepared according to your process, with the sulphates of iron and copper, since your reference to it in your circular of March, 1841, I have the gratification to state, that at the request of John Wurts, Esq., the President of the Delaware and Hudson Canal and Railroad Company, that piece of rope (it was such as is known as two inch rope,) was subjected, about two years ago, to the most powerful influence of heat and moisture I could produce, by means of a hot-bed, or fungus-pit. Along side of it was placed another piece of similar rope, not so prepared, which, when I opened the pit to ascertain the result, was found entirely rotten. I then replaced it with a *second* sound piece, laying it, as before, by the side of yours; and in due time, was found thoroughly decayed—and in the same way, a *third* piece was completely destroyed. Indeed, so severe was the test, and the preservation of the rope, at the end of the experiment, was so satisfactory, that it induced me to recommend your process to the Company, whose mines and railroad are under my charge, and who are in the use of large amounts, both of timber and rope, for the inclined planes. I am glad to find they have adopted my advice, and contracted with you."

I have thus endeavored to separate and rescue the "part which was prepared by Earle's process," and the process along with it, from the condemnation, or doubt, likely to be cast on them by the "note," and I will not scruple to say, that a consideration of the quality of the wood—the present actual state of this "part,"—and of the extent and character of the decay it exhibits—with a comparison of it and the adjoining pavements of the *same wood,* laid at the *same time,* —furnish a conclusion altogether corroborative of the preservative power of the process, and satisfactory to my utmost wishes.

In less space, and with less particularity, I could not have given what I consider as their true and proper position and aspect to facts, of which the "note" itself indicates the importance.

I am, respectfully, gentlemen,
Your obedient servant,
EDWARD EARLE.

Philadelphia, June 8th, 1842.

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. DUMAS.

Life, whose painful mysteries you are called upon to fathom, exhibits among its phenomena some which are manifestly connected with the forces that inanimate nature herself brings into action, others which emanate from a more elevated source, less within the reach of our boldest stretch of thought.

I. Plants, animals, man, contain matter. Whence comes it? What does it effect in their tissues and in the fluids which bathe them? What becomes of it when death breaks the bonds by which its different parts were so closely united.

These are the questions which we touched upon together, at first with hesitation, for the problem might be far above the powers of modern chemistry; we afterwards considered them with somewhat more confidence, as we felt from the silent and inward assent of our understandings that the path was sure, and that we could descry the goal gradually standing out, clear of all that obstructed our vision. If from these labors which you have witnessed, or, I should rather say, in which you have taken part; if from this scientific effort there have arisen some general views, some simple formulæ, it is my duty to become their historian; but allow me the pleasure of adding, that they belong to you, that they belong to our school, the intelligence of which has been exercised on this new ground. It is the ardor with which you have followed me in this career that has given me strength to pursue it; it is your interest which has sustained me; your curiosity which has awakened mine; your confidence which has made me see, and which proves to me at this moment that we are still in the path of truth.

These remarks will remind you of the wonder with which we found that, of the numerous elements of modern chemistry, organic nature borrows but a very small number; that from these vegetable or animal matters, now multiplied to infinity, general physiology borrows not more than from ten to twelve species; and that all the phenomena of life, so complicated in appearance, belong, essentially, to a general formulæ so simple, that, so to speak, in a few words the whole is stated, the whole summed up, the whole foreseen.

Have we not proved in fact, by a multitude of results, that animals constitute, in a chemical point of view, a real apparatus for combustion, by means of which, burnt carbon incessantly returns to the atmosphere under the form of carbonic acid; in which hydrogen burnt without ceasing, on its part continually engenders water; whence, in fine, free azote is incessantly exhaled by respiration, and azote in the state of oxide of ammonium, by the urine?

Thus from the animal kingdom, considered collectively, constantly escape carbonic acid, water in the state of vapor, azote, and oxide of ammonium, simple substances, and few in number, the formation of which is strictly connected with the history of the air itself. Have we not, on the other hand, proved that plants, in their normal life, decompose carbonic acid for the purpose of fixing its carbon and disengaging its oxygen; that they decompose water to combine with its hydrogen, and to disengage, also, its oxygen; that, in fine, they sometimes borrow azote directly from the air, and sometimes indirectly from the oxide of ammonium, or from nitric acid; thus working, in every case, in a manner the inverse of that which is peculiar to animals? If the animal kingdom constitutes an immense apparatus for combustion, the vegetable kingdom, in its turn, constitutes an immense apparatus for reduction, in which reduced carbonic acid yields its carbon, reduced water its hydrogen, and in which, also, reduced oxide of ammonium and nitric acid yield their ammonium, or their azote.

If animals, then, continually produce carbonic acid, water, azote, oxide of ammonium; plants incessantly consume oxide of ammonium, azote, water, carbonic acid. What the one class of beings gives to the air, the others take back from it; so that to take these facts at the loftiest point of view of terrestrial physics, we must say that, as to their truly organic elements, plants and animals spring from air, are nothing but condensed air; and that, in order to form a just and true idea of the constitution of the atmosphere at the epochs which preceded the birth of the first organized beings on the surface of the globe, there must be placed to the account of the air, by calculation, that carbonic acid and azote whose elements have been appropriated by plants and animals. Thus plants and animals come from the air, and thus to it they return; they are real dependences of the atmosphere.

Plants, then, incessantly take from the air what is given to it by animals; that is to say, carbon, hydrogen, and azote, or rather, carbonic acid, water, and ammonia.

It now remains to be stated, how in their turn, animals acquire those elements which they restore to the atmosphere; and we cannot see without admiring the sublime simplicity of all these laws of nature, that animals always borrow these elements from plants themselves.

We have, indeed, ascertained, from the most satisfactory results. that animals do not create true organic matters, but that they destroy them; that plants, on the contrary, habitually create these same matters, and that they destroy but few of them, and that in order to effectuate particular and determinate conditions.

Thus it is in the vegetable kingdom that the great laboratory of organic life resides; there it is that the vegetable and animal matters are formed, and they are there produced at the cost of the air.

From vegetables these matters pass ready-formed into the herbiverous animals, which destroy a portion of them, and accumulate the remainder in their tissues.

From herbiverous animals, they pass ready-formed into the carniverous animals, who destroy or retain some of them, according to their wants.

Lastly, during the life of these animals, or after their death, these organic matters, as they are destroyed, return to the atmosphere whence they proceeded.

Thus closes this mysterious circle of organic life at the surface of the globe. The air contains, or engenders, oxidized products, as carbonic acid, water, nitric acid, oxide of ammonium. Plants, constituting true reducing apparatus, possess themselves of their radicals, carbon, hydrogen, azote, ammonium. With these radicals they form all the organic, or organizable, matters, which they yield to animals. These, forming, in their turn, true apparatus for combustion, re-produce carbonic acid, water, oxide of ammonium, and nitric acid, which return to the air, to produce anew, and through endless ages, the same phenomena.

And if we add to this picture, already, from its simplicity and its grandeur, so striking, the indisputable function of the solar light, which alone has the power of putting in motion this immense apparatus, this apparatus never yet imitated, constituted of the vegetable kingdom, and in which is accomplished the reduction of the oxidized products of air, we shall be struck with the import of these words of Lavoisier:

"Organization, sensation, spontaneous movement, life, exist only at the surface of the earth, and in places exposed to the light. It would seem that the fable of the torch of Prometheus was the expression of a philosophic truth which had not escaped the ancients. Without light, nature was without life, was dead and inanimate: by the gift of light, a beneficent God spread upon the surface of the earth organization, feeling, and thought."

These words are as true as they are beautiful. If feeling and thought, if the noblest faculties of the soul and of the intellect, have need, for their manifestation, of a material covering, to plants is assigned the framing of its web with the elements which they borrow from the air, and under the influence of the light which the sun, its inexhaustible source, pours in unceasing floods upon the surface of the globe.

And as if, in these great phenomena, all must be connected with causes which appear the most distant from them, we must, moreover, remark how the oxide of ammonium, the nitric acid, from which plants borrow a part of their azote, are themselves almost always derived from the action of the great electric sparks which flash forth in stormy clouds, and which (furrowing the air through a vast extent,) produce there the nitrate of ammonia which analysis detects in it.

Thus, from the craters of those volcanoes whose convulsions so often agitate the crust of the globe, continually escapes carbonic acid, the principal nutriment of plants; from the atmosphere flashing with lightnings, and from the midst of the tempest itself, there descends upon the earth the other and no less indispensable nutriment of plants, that whence they derive almost all their azote, the nitrate of ammonia contained in storm-showers. Might not this be called, as it were. an idea of that chaos of which the Bible speaks, of those times of disorder and of tumult of the elements, which preceded the appearance of organized beings upon the earth?

But scarcely are the carbonic acid and the nitrate of ammonia produced, than a form more calm, although not of inferior energy, comes to put them in action; it is light. Through her influence, the carbonic acid yields its carbon, the water its hydrogen, and the nitrate of ammonia its azote. These elements unite, organized matters form, and the earth puts on its rich carpet of verdure.

It is, then, by continually absorbing a real force, the light and the heat emanating from the sun, that plants perform their functions, and that they produce, this immense quantity of organized, or organic, matter—pasture destined for the consumption of the animal kingdom

And if we add, that animals on their part produce heat and force in consuming what the vegetable kingdom* has produced, and has slowly accumulated, does it not seem that the ultimate end of all these phenomena, their most general formula, reveals itself to our sight?

The atmosphere appears to us as containing the primary substances of all organization, volcanoes, and storms, as the laboratories in which were first produced the carbonic acid and the nitrate of ammonia which life required for its manifestation, or its multiplication.

In aid of these comes light, and developes the vegetable kingdom, immense producer of organic matter; plants absorb the chemical force which they derive from the sun to decompose carbonic acid, water, and nitrate of ammonia; as if plants realized a reducing apparatus superior to all those with which we are acquainted, for none of these would decompose carbonic acid in the cold.

Next come animals, consumers of matter and producers of heat and force, true apparatus for combustion. It is in them, undoubtedly, that organized matter puts on its highest expression. But it is not without suffering from it that it becomes the instrument of sensation and of thought; under this influence, organized matter undergoes combustion; and in reproducing the heat and the electricity, which produce our strength, and which are the measure of its power, these organized, or organic matters, become annihilated, in order to return to the atmosphere whence they came. Thus the atmosphere constitutes the mysterious link which binds the vegetable to the animal kingdom.

Vegetables, then, absorb heat, and accumulate matter which they have the power to organize.

Animals, through whom this organized matter only passes, burn or consume it, in order to produce in its aid the heat and the different powers which their movements turn to account.

Suffer me, therefore, if, borrowing from modern sciences an image of sufficient magnitude to bear comparison with these great phenomena, we should liken the existing vegetation (truly a storehouse in which animal life is fed,) to that other storehouse of carbon constituted of the ancient deposites of pit-coal, and which, burnt by the genius of Papin and Watt, also produces carbonic acid, water, heat, motion; one might almost say life and intelligence.

In our view, therefore, the vegetable kingdom will constitute an immense *depot* of combustible matter, destined to be consumed by the animal kingdom, and in which the latter finds the source of the heat, and of the locomotive powers of which it avails itself.

Thus we observe a common tie between the two kingdoms, the atmosphere; four elements in plants and in animals—carbon, hydrogen, azote, and oxygen; a very small number of forms under which vegetables accumulate them, and under which animals consume them; some very simple laws, which their connexion simplifies still more: such would be the picture of the most elevated state of organic chemistry which would result from our conferences of the present year.

You, like myself, have felt, that before separating we have need of collecting our thoughts, of fixing with precision all the facts, of bringing together and summing up the opinions which explain and develope these great principles; lastly, that it was useful, as regarded your future studies, to give you in writing, and in a clearer form, the expression of these views, which were partly brought into existence under the stimulus of your presence, and consequently reduced into form with the hesitation which so often accompany the first enunciation of our thoughts.

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* "*Le règne animal*" in the original; but this is obviously an error.—Edit. *Phil Mag.*

[TO BE CONTINUED.]

Description of a new Universal Photometer. By DR. CHARLES SCHAFHAEUTL, *of Munich, Assoc. Inst. C. E.*

The inadequacy of the photometric instruments invented by Pictet, Rumford, and others, is universally acknowledged. The bromide of silver, as used by Sir John Herschell, although extremely sensitive, is only slightly affected by artificial light.

These circumstances induced the author to complete the present instrument, which he contemplated about twelve years since.

The intensity of the undulations of gaseous fluids, as well as that of the air, is proportional to the amplitude of the oscillations, or, more properly, to the square of the amplitude.

A wave of light striking the retina must create a similar vibratory motion in the nerves of the retina, because the velocity of the molecular movement of the nerves depends upon the force with which they have been struck by the original wave, and if this velocity could be measured, it would show at the same time the intensity of light.

It is scarcely possible to obtain a direct accurate measurement of this velocity, but if the time during which the vibratory motion of the nerves ceases be ascertained, the velocity of the vibrating molecules, and, therefore, the intensity of light, may be determined, because the duration of an impression on the retina is dependent on the resistance which the molecules of the nerves oppose to every force striking them; but as this resistance of the nerves increases as the square of the velocity, four times the momentum, or intensity, is necessary to double the time of duration—or, in other words, the intensity of the pencil of rays is as the square of the time of the duration of that impression made on the nerves of the retina.

The new photometer consists of a brass bar fixed vertically in a stand, carrying at its upper end a small tube in two parts, which may be lengthened from five to ten inches, if requisite. This eye tube has at each end a sliding plate pierced with holes of corresponding diameters. From the bottom of the bar a projecting arm sustains the lower end of a strip of rolled steel, eighteen inches long, $\frac{5}{16}$ths inch broad, and $\frac{1}{32}$nd inch thick; this has at the upper end a thin plate, pierced with a small hole, corresponding with the holes in the sliders, and standing one-eighth of an inch from one of them: upon the main bar is a prism with a slit in it, through which the strip of steel passes; this prism can be moved up or down, by a rack and pinion, so as to lengthen or shorten the vibrations of the strip.

The method of using the instrument is to adjust the two holes at the opposite ends of the horizontal eye tube, so that they perfectly correspond, and do not permit any rays of light to enter, unless the plate at the extremity of the spring be pushed aside. The light to be compared is then placed at a certain given distance behind the plate, so that by bringing the axis of the hole which is pierced in it into the axis of the tube, a small pencil of light may enter the pupil of the eye. The prism is then placed at 100 of the scale on the side of the brass bar, and the steel strip caused to vibrate gently. A luminous disk immediately appears, accompanied by scintillations, which are caused by the impressions on the retina being interrupted by dark intervals: the prism is then gradually raised, until the length of the vibrations of the strip being diminished, and the velocity increased, the luminous disk appears perfectly steady and clear. The length of the vibrating portion of the strip is then read off by the verniers marked on the brass rod, and compared with the whole length of the spring, measured from 100, which is considered as unity. The number of the vibrations to be computed from the found length of the spring, are inversely to the numbers of vibrations of the whole length, as the squares of their relative lengths. Hence are constructed the formulæ for calculation, which are given at length in the communication.

A fresh luminous impression is made on the retina as often as the circular aperture in the screen, on the top of the spring, cuts the axis of the tube. If the duration of the small vibration of the nerves of the retina is shorter than the time of a vibration of the spring, a dark interval appears between the two luminous impressions. In this case the vibration of the spring is shortened until the next impression returns just as the first ceases, and therefore the dark interval disappears; then by measuring the length of the shortened spring, the number of vibrations can be computed, and from them the intensity of the light.—*Trans. of the Inst. of Civ. Eng.* Jour. of Arts & Sci. Nov.

Propagation of Sound.

M. Colladon has forwarded to the French Academy of Sciences an account of some experiments he had been making on the Lake of Geneva, relative to the propagation of sound; he had tried over again an experiment made by Mr. Bonnycastle, on the coast of the United States, in 1838, and recommended by M. Arago, in order to find whether sound could be reflected back from the bottom of a lake, or piece of water, and by measuring the time of its passage, to calculate the depth of the water. Mr. Bonnycastle had not been able to hear the sound of a bell under water at a greater distance than 8000 or 10,000 feet, but M. Colladon had succeeded in propagating a sound of this kind to the distance of 13,500 metres, or 42,640 feet; he had also found that when a blow was struck on a bell partly out of water and partly under water, two sounds were heard, one coming by the air, and the other by the water. At a little distance the latter was the less strong of the two, but at a great distance the contrary was the case, and the sound transmitted by the water was the more intense; it could even be heard when that by the air was totally imperceptible; he was of opinion that, under favorable circumstances, sound might be transmitted through the sea for a distance of 100,000 metres, or upwards of sixty English miles. Mining Jour.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Harvey Leach's Suspension Railway Ferry and Drawbridge.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Suspension Railway Ferry and Drawbridge, invented by Mr. Harvey Leach, of Philadelphia, Pennsylvania, REPORT:—

That they have examined the outline drawings, and the model, submitted to the Institute by the projector, and find that his devices have two leading features, which make it convenient to treat them separately, as follows:

I.—*Of the Suspension Railway Ferry.*

Here the design is, to carry a railway across navigable waters, at such an altitude as to permit the free passage beneath it of ships under sail; to suspend from a large truck, running upon this railway, a fenced platform, of sufficient dimensions, and at a proper level, to receive passengers and freight from piers on both shores. This pendant deck, or platform, when required, is to travel from side to side—by the aid of suitable machinery, acting upon the truck carriage—and is thus designed to provide a means of transport over the water, at intervals longer or shorter, according to circumstances.

The two lines of rails are to be supported, each upon the inner side of the lower chord of a lattice truss of iron, very similar to that of Smart's well known bridge, patented in England, 4th of July, 1822,* and recommended by the patentee to be applied to pendant bridges, precisely as is here done. The antecedent patent, of Ithiel Town, January 28th, 1820, also covers lattice trusses of iron, as well as those of wood, so well known in this country.

Each of the trusses which carry the rails is proposed to be strengthened and sustained by chains, or cables, of iron, suspended in the usual manner from the summits of piers, which rise above the trusses for that purpose, and which are to be formed of pillars, kept separate as high as the rails, to allow a free transit of the pendant deck, in both directions.

In the lithographic engraving before us, several cables are represented as attached to one truss; they are arranged in different curves, one above the other, as in the wire bridge constructed by Mr. Ellet, at Fairmount; and in the particular plan referred to, it is not designed to secure the chains, or cables, to either bank, but simply to fasten them to, or connect them with, the truss, at equal distances on both sides of the piers—the trusses projecting (for that purpose) towards the land, from each shore pier, a distance equal to about half the adjacent span. If the model in the hall of the Institute were sawn asunder, transversely, in the middle, the parts of the truss would remain balanced by the cables over each land pier as a fulcrum, and would in that case very closely resemble the trusses of the lattice suspension drawbridges used upon the railway between Philadelphia and Wilmington; and the same principle—that of balancing the bridge upon suspending bars, extending equal distances from the supporting piers—was long since used by Wernwag, the celebrated carpenter, in constructing a bridge across the Neshaminy Creek, in this State.

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* London Journal (Newton's) of Science and the Arts, vol. v, page 233.

The *main details* of the project before us, cannot, therefore, be regarded as novel, and its *general features* appear to us to interfere with "Fisher's Suspension Railway," patented in England, 2nd of April, 1825,* which had in view the same object, viz:

"To construct railways by throwing chains from any two points, as over a river or ravine, or across a swampy ground; and to suspend from the catanarian curve of the chain, by means of perpendicular rods, a straight rail, upon the lower side ledges of which the wheels of carriages are to run."

These carriages in Fisher's patent (of which the form is not described,) were to be pendant below the suspension railway, and travel from shore to shore, like the hanging deck, or platform, of the project before us.

In view of these considerations, the Committee, whilst they cannot recommend Mr. Leach's project on account of its *novelty*, must (for obvious reasons) leave the question of its *utility* to be decided by its cost, and the particular circumstances of those localities, where such devices may be considered applicable, merely remarking, in conclusion, that the capacity of existing means of transportation across navigable waters, where common bridges are inadmissible, is such, as to leave but little to be desired, in point of speed and certainty—except where masses of ice present an obstruction to the progress of vessels propelled by steam.

II.—*Of the Suspension Railway Drawbridge.*

This is a modification of the other project, and is designed to be applied in chief to railways arriving at the banks of navigable waters, at an elevation so low as to preclude their passage without obstructing the navigation—such, for example, as the railway approaches to the Susquehanna River, at Havre de Grace. In these cases, Mr. Leach proposes to bring out the railway, from both shores, upon suspension bridges, to two very elevated piers upon the margin of the channel, some three or four hundred feet apart; to erect centrally between them, a third pier, of the same altitude—thus forming two channel spans—and to suspend from these three piers, by flat catenarian curves, a lattice truss, high enough to clear the shipping, and having movable, upon a railway thereon, a pendant platform, of the full length of one span; this movable span is to be wholly or partially withdrawn, into the other, whenever vessels are to pass. This is an application of Fisher's patent to a new use, and upon it must rest Mr. Leach's claim to *novelty* in this branch of his scheme.

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* London Journal (Newton's) of Science and the Arts, vol. xi, page 98.

From the summits of the tall marginal piers above mentioned, the cables, or chains, are to sweep down towards both shores in a catenarian curve, of which the land piers of suspension will be comparatively low, and the vertex, consequently, much nearer to the banks, than to the piers of the drawbridge.

From this description, it will be at once perceived that practical difficulties must flow from such a plan, owing to the inequality of the angles of inclination of the tangents of the catenaries, at the points of suspension, as well as to the unequal loads imposed upon the channel spans by the operations of the drawbridge; and it is a question not yet affirmatively settled in the minds of the Committee, whether suspension bridges are as suitable as others to carry the trains usually drawn on railways by locomotive steam power?—for it is certain that the attempts hitherto made to apply such bridges upon railways, have not succeeded, and it is probable that to render them successful (at least in such long spans as those of the project before us,) it would be necessary to increase the weight of the chains so prodigiously, as to render the expense too serious to be encountered in ordinary cases.

Under these circumstances, without entering further into detail, the Committee are not prepared to recommend Mr. Leach's drawbridge project for general use in navigable waters, though they incline to the opinion that, in a modified form, it may possibly be applicable in some cases, if its expense does not forbid its adoption.

By order of the Committee,
March 10*th*, 1842. William Hamilton, Actuary.

Grimes' Smut Mill.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Smut Mill, invented by Mr. William C. Grimes, of York, Pennsylvania, REPORT:

That they have examined the machine, and obtained such information relative to its practical efficiency, as was within their reach. The operation which it is designed to perform is one of peculiar difficulty, and has hitherto been executed very imperfectly. The smut balls, as they are termed by the miller, are so nearly of the same size and weight as the grains of wheat, that no means have ever been devised for removing them without first breaking or crushing, and afterwards riddling or winnowing, or both.

When the smut is thus broken, the finer portions of it have a tendency to adhere to the wheat, especially by insinuating into the cleft of the grain, and cannot then be removed. Mr. Grimes has contrived this machine with a view to remove the difficulty, by subjecting the smutted wheat, simultaneously, to the action of revolving beaters, which shall break the smut, and a strong current of air, which shall blow away the fragments before they can attach themselves to the grain.

The beating is effected by thin cast iron webs, fixed longitudinally on the exterior of a vertical cylinder, which revolves within a cylindrical cast iron case, the inner surface of the case being fluted longitudinally, to prevent the grain from being carried directly around with the revolving cylinder, and cause it to rebound repeatedly when it has been thrown against the case by the centrifugal motion communicated by the beaters.

The interior cylinder extends a few inches above the top of the surrounding case, and the webs which form the beaters are here expanded radially, so as to form vanes for the production of a strong upward current of air in the annular space between the cylinders.

The grain to be cleaned enters this space near the upper end; as it descends by gravity, the smut is broken by the beaters, on the well known principle of the increased resistance of a fluid medium in proportion as the mass of the penetrating body is diminished, the powdered smut is blown out at the top, while the larger grains of wheat descend and escape through an opening below. Beside the main features now described, there are several minor devices, which are ingeniously adapted to lessen certain practical difficulties, particularly those to prevent the blowing out of the wheat before it has acquired sufficient downward velocity to resist the blast, and the dangerous tendency to overheating the upper journal, which deserve commendation; but as they do not constitute any part of the general principle, it is not thought necessary to complicate the report with a particular description of them.

From a mere inspection of these several contrivances, the Committee would be inclined to form a favorable opinion of their adaptation to their intended object; but as the cleaning of smutted wheat is an operation which cannot be reduced to any certain rules of mechanics, and can, therefore, only be judged of by experiment on a practical scale, inquiry has been made of parties using the machine, and it has been examined in actual use. The result of this inquiry and examination has fully confirmed the good opinion of the Committee, and they feel warranted to commend the machine to the notice of millers, as capable not only of making good white flour from wheat so badly smutted as to be generally considered unmerchantable, but which will also improve the general quality of his flour by the removal of cheat and of the down, or furze, which covers one end of the grain, and of most other accidental foreign matters which tend to injure the quality of the flour.

In conclusion, the Committee take pleasure in recommending this invention to the Managers of the Institute for an award of the Scott's Legacy premium.

By order of the Committee,

March 10*th*, 1842. William Hamilton, Actuary.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Railroad Carriages;* Albert Bridges and Charles Davenport, Cambridgeport, Middlesex county, Massachusetts, May 4.

This improvement is in the manner of suspending the body of the car to the frame, so as to give it a free oscillating, or pendulous, motion, which may be checked by side springs, to avoid the unpleasant and injurious jarring motion, occasioned by the striking of the flanches of the wheels against the rails.

Claim.—"We claim supporting the carriage, or body of the same, upon, or connecting it to, the wheel frame, by means of the rough braces, or pendulous bars, or links, either suspended or not, at pleasure, to springs on the wheel frame, and arranged according to the modes represented (all of which modes permit a lateral motion of the running machinery, independent of the body of the carriage,) in combination with the side springs, opposed to said lateral motion, and which are disposed and operate substantially, in the various ways described."

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2. For an improvement in the *Press for Cheese, &c.;* Damon A. Church, Friendship, Alleghany county, New York, May 4.

The follower of this press is forced down by means of a weight, the cord from which is attached to, and actuates, a double ratchet wheel, which has its shaft hollow, and is received on to a shaft carrying two double scroll wheels, one on each end. The cords are then conducted in such a manner over pulleys, as to effect the pressure by means of the weight; but the arrangement cannot be readily described in words alone, and we therefore pass to the claim.

Claim.—"What I claim, and desire to secure by letters patent, is the manner in which I have arranged and combined the respective parts thereof, so as to accomplish the desired end—that is to say, the manner in which I have combined the double ratchet wheel with the shaft—the (double scroll) wheels and the cords winding around said shaft, and passing over the pulleys in the movable pieces; by which combination and arrangement, the weight which is attached and suspended, in the manner described, produces a progressive and continuous pressure upon the cheese, or other article to be pressed. It will be manifest that considerable difference may be made in constructing this machine without departing from the general principle, or mode of action, upon which it is dependent; I do not intend, therefore, to limit myself in this particular, but to vary this machine as I may think proper, while I produce the same effect, by means substantially the same."

3. For improvements in the *Horse Power* for driving Machinery; J. Francis Moore, Falmouth, Stafford county, Virginia, May 4.

In this machine there is to be a main horizontal wheel, which is to be drawn round by the horse, and this has truck rollers attached to the under side of its rim, which run on circular rails on a suitable platform. This wheel, by means of cogs on its inner periphery, drives a small wheel, to the axis of which is affixed another large wheel, which runs on truck rollers on a second platform, and, by means of cogs on its inner periphery, drives a pinion, or small cog wheel, from the shaft of which motion may be communicated to a thrashing machine, &c.

Claim.—"What I claim is the manner in which I have combined and arranged the respective parts thereof—that is to say, I claim the combination of the two wheels with the two platforms and with each other, in such manner as that said wheels shall be supported on their respective platforms by trucks, or friction wheels, and revolve thereon without the aid of axles, or gudgeons. I claim, also, the particular arrangement and combination of the four wheels, in the manner set forth—the two larger wheels having cogs, or teeth, on the interior of their rims, and mashing into, or engaging with, the two smaller, by an arrangement of the respective parts, substantially the same with that herein described."

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4. For an improvement in the *Harvesting Machine*, for cutting, thrashing, and winnowing Grain; Damon A. Church, Friendship, Alleghany county, New York, May 4.

On the forward part of this machine there is a set of V shaped cutters, with points that separate the heads of the grain from the straw; above these cutters there is a gathering wheel, with strips that reach from end to end, to catch the heads of the grain, as the gathering wheel revolves, and force them against the V cutters, which separate them from the stocks. The heads of grain are delivered from the cutters on to an endless apron, which extends along behind the cutters until it arrives at a point where it meets two endless aprons, between which the grain is conducted up to a thrashing machine, of the usual construction; from the thrashing cylinder the grain and straw are discharged on to an endless apron of netting, with meshes sufficiently small to prevent the passing through them of the thrashed heads, but allowing the grain to fall upon another endless apron, which carries it back, until it falls down in rear of a fan wheel, by which the chaff and dirt are blown out, whilst the grain descends into a box. The cutters are each hung upon a joint pin at the heel, and are borne up against the gathering wheel by a spring.

The claim is to the "manner of constructing the knives, or cutters, so as to hang each of them upon a rod, or joint pin, whilst they are each sustained by a spring, as described." Also, to the combination of the apron that receives the grain from the gathering wheel, with those that conduct it to the thrashing cylinder; and, finally, to the endless apron of net work that receives the grain, &c. from the thrashing cylinder, with the one that conducts the grain to the fan.

5. For an improvement in *Mill Spindles and Vertical Shafts;* Jacob Staub, Georgetown, District of Columbia, May 4.

The patentee says:—"The object which I design to obtain by my improvement, is to have less friction, and to give better opportunity to repair the end of the spindle."

At the bottom of the step, or ink, there is a movable *plug*, which runs up into a hole made in the bottom of the spindle, or shaft, the upper part of the said hole being occupied by another movable plug, which has a small hole through its whole length, to receive and conduct oil from the box, in which the whole works—the oil escaping through a lateral hole in the lower end of the shaft, or spindle. As the whole weight of the shaft rests on these two removable plugs, the wear will be confined to them, and when worn, they may be removed and replaced by others, simply by taking out the spindle.

Claim.—"What I claim as my invention, and improvement, and which I desire to secure by letters patent, is the arrangement of the lower removable plug in the step, or bed, in combination with the upper removable plug, in the spindle, or shaft, and provided with a hole to admit oil from the box, for the purpose, and in the manner, specified."

6. For an improvement in the manner of constructing *Paddle Wheels* for Steamboats; P. G. Gardiner, New York City, May 4.

"On each of my paddle wheels I use a double row, or series, or a greater number, of buckets; which buckets are placed so as to form an angle with the axis of the wheel; and I deem it best to place them so as to stand at an angle of forty-five degrees, or nearly so, with said axis, or shaft; but a variation of from four to five degrees from this angle may be made without materially interfering with the action of the wheel. In constructing my wheel with a double row, or series, of buckets, there must be three sets, or series, of arms, the middle being twice as numerous as the two outer series, the buckets of each outer series meeting in the middle. I do not claim the mere placing of the buckets in such a manner as to form an angle with the axis, or shaft, of the wheel—this having been done, but with other views, and under arrangements differing from those adopted by me;—but what I do claim as constituting my invention, and desire to secure by letters patent, is the placing of a double series of buckets so to form an angle of forty-five degrees, more or less, with the axis of the wheel; said buckets having each of their inner ends attached to a distinct arm, thus allowing a free or open space between each bucket, in each series of buckets, as set forth; said buckets being convoluted in consequence of their being attached to radial arms, in the manner described."

7. For improvements on his *Cap Spinner;* also applicable to others; Charles Danforth, Paterson, Passaic county, New Jersey, May 4.

The lifters in this cap spinner, as in that originally patented by Mr. Danforth, are worked by arms radiating from the main driving shaft; on each end of the said driving shaft there is a grooved pulley, from which a band runs to two inclined grooved pulleys on each end of the lifter, and passes along in front, and returns along the back, of the lifter—it being supported, as it passes, by guide pulleys, ranged along the front and back edges thereof. On this belt the bobbins rest, and by it they are driven. The inclination of the inclined groove pulleys must be such as to receive the band from, and return it to, the grooved pulleys on the ends of the main shaft, in a proper direction, to prevent them from running off. The spindles are oiled along that part of their length over which the bobbin passes, by means of a tube attached to the lifting rail, which dips into an oil cup at the bottom of the dead spindle, and spreads the oil as it ascends with the lifting rail.

Claim.—"The principle of this invention, for which I claim a patent, consists of the combination of the main shaft, and pulleys thereon, with the inclined pulleys on the lifters, and the pulleys and radius rods, carrying, sustaining, and guiding, a band, or cord, so as to drive the bobbins resting on the band, or cord, at the required rate and force, the bobbins being constructed and kept supplied with oil, as aforesaid, substantially as above. I also claim the method of supporting, guiding, and working, said endless band, or cord, by means of the inclined carrying pulleys on the lifters, and the grooved end pulleys in connexion with the grooved pulleys on the main shaft, thereby giving motion to the bobbins, by causing an endless band, or cord, to pass under them, with their weight bearing on said band, or cord, substantially as aforesaid, by whatever mechanical means the regulating action, effected by the radius rods, may be produced. I also claim the reciprocating motion given to the grooved end pulleys by means of radius rods, studs, and brackets, essentially as herein described. I also claim the method of applying oil to the spindles and bobbins, in spinning machinery, substantially as above described. And I further claim as my invention, the use of inclined pulleys upon lifters, carrying and guiding a band, or cord, upon which bobbins are made to rest and to be turned, substantially as aforesaid, by whatever mechanical means the said band, or cord, may be guided to and from said inclined pulleys, as the said lifters rise and fall in the operation of any spinning machine to which said inclined pulleys, bands, or cords, may be applied. I also claim the combination of pulleys, whether inclined or not, upon the lifters, with a band, or cord, and bobbins, resting upon them, and carried by said band substantially as aforesaid. I also claim the combination of pulleys, inclined or not, upon spindle rails, carrying, guiding, and moving bobbins, by the weight of these, on a band, or cord, as aforesaid."

9. For a machine for *Separating Gold from its Ores;* Thomas Seay, Columbia, Georgia, May 4.

This machine is very similar to others which are used for the same purpose, differing from them in some particulars which have been deemed sufficient to become the foundation of a patent; the following is the claim:

"What I claim as my invention, and desire to secure by letters patent, is, constructing the rocking trough, or amalgamator, with an undulating surface on its bottom plank, in combination with the top plank, provided with pins, and fitting into said trough, which will produce the desired effect.

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10. For an improvement in *Bee Hives;* Constant Webb, Willingford, New Haven county, Connecticut, May 4.

The claim on which this patent was granted, gives the character of the improvement with sufficient distinctness; we deem it unnecessary, therefore, to offer any other description of it.

Claim.—"I do not claim as my improvement the movable bottom merely, nor the suspension of the hive for protection from the moth, as both are common; but I do claim as my invention and improvement, and as new and useful, the peculiar form of the construction of the hive, by making the front board shorter than the sides and back, so that the bottom is made to slide in, and rest on cleats attached to the inside of the sides, and can be wholly drawn out for the convenience of hiving bees, and when hived, can be replaced, and the hive closed without shaking it or disturbing the bees, till the hive and its contents are safely removed to their proper station; all which I claim, in combination with the mode of suspending the hive so as to make the bottom an inclined plane, while the top and body of the hive project forward, to protect the bees from storms, &c., all as described."

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11. For improvements in the *Fanning Mill,* for cleaning Wheat from smut, garlic, &c.; David Philips and Asa Jackson, Franklin Mills, Mercer county, Virginia, May 4.

This machine is constructed for the purpose of separating, by a current of air, the pure wheat from garlic and other impurities, the specific gravity of which may be less than that of wheat.

The grain passes in a thin stratum down an inclined plane, to a vertical flue, or aperture, where it is met by a strong current of air, from a fan, which deflects the various materials, according to their specific gravity. Below the flue there are three vertical plates, the first being immediately under its forward part, and the other two at appropriate distances apart—thus forming two flooms—the upper edges of the last two being armed with sliding plates, or regulators, which are bent forward towards the current of air. The pure wheat, which is said to be the heaviest, will fall between the first and second vertical plates, the next heaviest between the second and third, and all the light impurities will be discharged at the back part of the machine.

Claim.—"What we claim as new, and of our own invention, and which we wish to secure by letters patent, is the construction of the winnowing machine, or fan, with a vertical flue, or aperture, as set forth; in combination with the inclined plane, and the vertical plates, the two first being governed by regulators."

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12. For an improvement in the *Seed Planter;* Joseph Gibbons, Adrian, Michigan, May 4.

A patent was granted to Mr. Gibbons, for a seed planter, on the 25th of August, 1840, and is noticed in this Journal, vol. ii, 3rd series, page 258. The improvement referred to in the above title, is added to this patent. The patentee says:

"My improvement is intended to be applied to the said machine (referred to above) when it is constructed for the purpose of planting a single row of seed. With this intention, I make perforations in several rows around a planting cylinder, which holes are to vary in size and number according to the nature of the seed to be planted. Above this cylinder I place a hopper for containing the seed, which hopper is so formed and arranged as to be capable of being slid along from end to end of the planting cylinder, so that the opening on its lower side, through which the seed is to pass into the cavities, or excavations, in the planting cylinder, may be made to stand directly over either of the rows.

"Having thus fully described the nature of my improvement in my planting machine, what I claim therein, and desire to secure by letters patent, is the manner in which I have formed and combined the planting cylinder and hopper, as above set forth—that is to say, a cylinder having several rows of cavities, or excavations, around its periphery, with a hopper placed above it, and made capable of sliding along it, substantially in the manner, and for the purpose, set forth. I also claim the manner of placing the guide wheel in front, and on one side of the machine, so as to allow of its being readily tilted, to cause the share to make a furrow of greater or less depth."

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13. For an improvement in the manner of *arranging the Keys of a Piano Forte;* John Dwight and Daniel B. Newhall, Boston, Massachusetts, May 6.

The above named improvement is for "curving the front ends of the keys, and arranging them on a curved line." The patentees say: "The nature and character of our improvements are to facilitate the execution of music on the piano forte and other keyed instruments, particularly when the bed of keys is long, consisting of six, seven, or more octaves, by which a performer is enabled to reach the extreme keys more conveniently."

Claim.—"What we claim as our joint invention and improvement, is the concave curvature of the bed of keys in front, as described."

14. For an improvement in *Door Locks;* John P. Sherwood, Sandyhill, Washington county, New York, May 6.

This alleged improvement in door locks consists in the mode of moving the bolts by means of a weight instead of by a spring. The weight, which works the latch bolt, and which is called a *car* by the patentee, slides at an angle of about forty-five degrees with the bottom edge of the lock, on a stud pin, and on the spindle of the knob, it being provided with two slots for that purpose; this weight is connected with the rear end of the bolt, by a connecting link of a peculiar form.

Claim.—"I do not claim the employment of a weight to work the latch bolt, as a substitute for a spring—that having been previously done; but what I do claim as my invention, and desire to secure by letters patent, is the method of working the bolt by means of the sliding inclined car, as described, and also the mode of connecting the latch bolt with the sliding car, by means of the link, for the purpose, and in the manner, described."

15. For improvements in the machine for *Removing Obstructions, or Bars, from Harbors, Rivers, &c.;* James R. Putnam, New Orleans, Louisiana, May 11.

The sand, mud, or other earthy obstructions, at the bottom of rivers, &c., is first to be loosened, by drawing through it a series of ploughs, attached to a frame, which is provided at its back with a number of cutters, to subdivide the furrows made by the ploughs. After the obstructing earth, &c., has been loosened as above stated, a second machine is dragged over it, in order to remove it; this machine consists of two inclined scrapers attached to a frame, one behind the other, and in front of each scraper there is a plate, the upper edge of which is jointed to the frame. When this machine is passed over the earth, the jointed, or swiveled, plates, are closed up, leaving a narrow space between their edges and the scrapers, through which the earth, sand, &c., is forced, and is thereby lodged on the plates, and when the whole is drawn into deep water, the weight of the contents opens the jointed plates, and thus the earth is discharged. These two machines are suspended by chains to two boats, the forward boat being used to drag, and the back one to regulate the depth to which the machines shall sink.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the scrapers with the swivel plates, for the purpose, and in the manner, described. Also, the arrangement of ploughs, in combination with the cutters, for the purpose, and in the manner, described."

16. For an improvement in the *Washing Machine;* George Waterman, Johnston, Providence county, Rhode Island, May 11.

This machine consists in part of two dashers, that are worked up and down in a trough, or box, by two levers, and by tappets on a shaft, which act on one end of the said levers, the other end passing through a loop on the handle of each dasher. At the bottom of the box in which the dashers, or pestles, work, there is a rocking false bottom, which is called a vibrating bottom, and is pierced with small holes, for the passage of the water that is to be squeezed out of the clothes, which are placed on the said false bottom, and upon which the dashers fall.

The claim is to the "vibrating bottom, in combination with the dashers," as specified.

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17. For improvements in *Hot Air Furnaces and Fire Grates;* William H. Whiteley, Charleston, Suffolk county, Massachusetts, May 11.

The claim in this instance refers throughout to the drawings, and is, therefore, omitted. It is confined to two improvements, the first of which consists in an arrangement of flues for heating the air that is to be conveyed to the apartments to be heated, and the second to an arrangement of the grate, in combination with a catch, which answers the double purpose of holding the grate in its place, and of scraping off the cinders in cleaning out the fire chamber.

The fire chamber is surrounded by two concentric cylinders, except where the door is placed for the admission of coals, &c., with a space between each—the inner cylinder being pierced with holes. The fire chamber is covered by a plate, in which are inserted tubes for the passage of the draught, and of the air to be heated. The cold air is admitted into the outer space around the fire chamber, from which it passes, through the holes in the inner concentric cylinder, to the chamber surrounding the fire cylinder, thence into some of the flues above the fire chamber, which are surrounded by the draught flues, that carry off the gaseous products of combustion into the chimneys; and the heated air is conducted by pipes, governed by dampers, into the apartments to be warmed.

The grate is made with side pieces, or cheeks, of a wedge-like form, that slide on inclined bed pieces, and the catch, which holds the grate in its place, is hinged to the furnace, directly in front of the grate, and catches in a mortise made for that purpose. When the grate is drawn out, the catch drags over the top of the bars, and clears off the cinders.

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18. For an improved method of constructing *Cocks for Hydrants;* Ebenezer Hubball, Baltimore, Maryland, May 11.

This improvement consists in a method of constructing the piston of the valve and the screw pipe through which it slides, and by which it is secured to the cock and valve seat, so that the screw cap may be unscrewed, and the valve and piston removed from above, without removing the hydrant; all which is to be effected by making the piston square, or polygonal, and fitting it into a hole of the same form, in the screw cap, instead of making it round, as heretofore.

The claim is confined to the above described improvement, and the patentee says:—"Although I make use of the terms square and polygonal, I would conceive my patent infringed by the use of any shape of piston and opening in the screw, whereby the same power to unscrew and screw in again, without disturbing the hydrant, would be obtained."

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19. For an improvement in the *Smut Machine*, for cleaning Grain; Jacob Dimuth, Benjamin Banman, and Levi Beck; the two former of Lancaster township, and the latter of Lampeter, Lancaster county, Pennsylvania, May 11.

To a suitable shaft are attached four metal disks, placed at given distances apart, and four sets of bars, passing through holes in, and attached to them, constitute four open beaters, extending, radially, from the shaft to the periphery. The four spaces, into which the diameter is divided, between the two inner disks, are occupied by four similar beaters, the bars of which are of smaller size than those first named. The spaces between the two inner, and the two outer, disks, are occupied by solid beaters, consisting of plates, some of which are parallel with the axle, and others placed obliquely. This beating apparatus revolves within a drum, or cylinder, the periphery of which is formed of triangular bars, and which revolves in a direction the reverse of that of the beater—the whole being placed horizontally.

The claim is to the beater, constructed in the manner stated, "in combination with the cylinder, constructed with angular straps, as described, the beater and cylinder revolving horizontally, and in opposite directions."

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20. For an improvement in the *Wind Chest for blowing the fires of Forges and Furnaces;* Charles Foster, Rochester, Monroe county, New York, May 11.

The patentee says:—"I disclaim the original invention of the bellows box, and what I claim as my invention, and desire to secure by letters patent, is the method of constructing the top of the box by forming it with two oblong apertures, or tubes, inclined towards each other, for the purpose of concentrating the draught of air, and increasing its power of action on the fire."

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21. For an improvement in *Paddles for propelling Boats;* Samuel Swett, Jr., Chelsea, Suffolk county, Massachusetts, May 11.

"The paddles, or buckets, by which the propelling is to be effected, are attached to frames which stand horizontally, and which are made to vibrate back and forth, and are raised up and down by means of cranks. The paddles, or buckets attached to the vibrating frames, would, were they immovably affixed thereto, dip into, and rise from, the water vertically; but instead of so attaching the paddles to vibrating frames, I hang them upon pivots, which admit of their having a vibrating motion communicated to them, independently of that which they receive with the frame. The intention of this is to cause them to enter, and to leave, the water in a direction varying a few degrees from a vertical line; and this they are made to do by means of eccentrics upon the ends of the cranks which carry the vibrating frames, there being shackles, or connecting rods, from said eccentrics, leading to, and connected with, one or more of the paddles. I intend, in general, to use two vibrating frames, each carrying three paddles, on either side of the boat, or other vessel.

"What I claim as constituting my invention, and desire to secure by letters patent, is the giving to the paddles, or buckets, in the particular kind of apparatus herein described for propelling boats, or other vessels, an independent vibratory motion within the vibrating frames to which they are attached, for the purpose of causing them to enter, and to leave the water in a line inclined from the perpendicular, as described.

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22. For an improvement in the *Machine for Packing Tobacco;* Thomas Samson, Richmond, Virginia, May 11.

This apparatus consists of four staves of cast iron, or other metal, cast hollow, their outer surfaces being segments of a circle, and their inner surfaces straight. The edges of these staves, where they come together, are united. These staves are placed one against each side of the tobacco box, and by means of hoops and wedges, they and the box, and the tobacco within, will be drawn together.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the constructing and using of four staves, or billets, of cast iron, or other metal—said staves being cast hollow, and having their contiguous edges formed with a mitre joint, or in such a manner as will admit of their being drawn together by means of bands, or hoops, by which they and the contained box are to be embraced when in use."

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23. For an improvement in the *Argand Lamp, for burning Spirits of Turpentine, &c.;* John S. Tough, Baltimore, Maryland, May 11.

"The reservoir and burner are made in the usual manner of Argand's lamp, except the outer cylinder of the latter, which is made about an inch higher than the inner cylinder, and slightly flaring outward. The principal improvements are in the construction and arrangement of a sliding cylinder, which fits the inner cylinder of the Argand's burner, having its upper end enlarged, so as to fit the space between the inner and outer cylinders of the burner being flared outward, so as to press the wick against the inside of the outer cylinder, which is also made slightly flaring outward, as before noticed, provided with a funnel-shaped button, or inverted conical regulator, which slides up and down, for concentrating the air around the flame, and increasing its intensity, and a glass globe, with a circular rim inside the same, made in the form of a hollow frustum of a cone rising inward from the lower rim of the globe, for contracting the space and impinging the column of air around the flame; the slope of said flanch extending downward from the flame, outside the wick, whilst the slope of the button extends also down from the flame, but inside the circle of the wick.

"What I claim as my invention, and which I desire to secure by letters patent, is the combination of the conical rim at the bottom of the globe, with the inverted cone regulator, or button, and adjustable cylinder, adapted to, and combined with, the wick case, as set forth."

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24. For an improvement in the *Self Sharpening Plough;* Isaac Snider, Carrollton, Pennsylvania, May 11, 1841; which improvement was added to a patent granted to him on the 29th of July, 1837, noticed in this Journal, vol. xxi, 2nd series, page 273.

The claim in this instance refers throughout to the drawings, and is therefore omitted. The first item claimed is to the making a groove in that part of the mould-board which is hollowed out to receive the share, there being a projection on the share to fit into the said groove. The second item is for making the cutter with two hooks, one to hook on to the neck of the mould-board, and the other to hook below the point, to "support the same; by means of which arrangement, the cutter serves as a clamp to hold the mould-board and point together." The third item is for making the cutter in two separate pieces, with a depression to admit a movable blade, fastened in by two rivets, "which enables the farmer to change the edge from wrought iron to steel." And the last item is for making the share in two pieces, with a tenon in front, to receive a movable blade, for the same purpose for which the cutter is made in two.

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25. For an improved apparatus, called a *Walking Aid*, for the relief of persons who are unable to walk, from weakness of the knee or ankle-joints; Stephen P. W. Douglass, Williamson, Wayne county, New York, May 15.

This apparatus resembles, in its general features, others which have long since been in use for the same purpose, and which are well known to surgeons. The apparatus consists of side plates running along the side of the thigh and leg, jointed together at the knee, and attached to the hip, the knee, and the foot, by appropriate straps, &c. There is a spring which bears on the thigh and leg plate, and which is connected with the knee joint by means of a screw, said screw serving to increase the tension of the spring, which thus constantly tends to straighten the knee. The knee joint of the apparatus is connected with the limb by means of a "patella cap," which embraces the knee above and below, one side being hooked to the screw, where it forms the connexion with the apparatus, and the other to a strap that passes under the limb, but not in contact with it, and is attached to the screw, where it passes through the spring—thus avoiding the binding of the limb all around, which would tend to arrest the circulation of the blood. The attachment to the foot is by means of straps that pass under the foot, around the heel, and over the in-step, and then to a bow-piece attached to the lower end of the side plate. There are various modifications described in the mode of applying the spring, by substituting, for that above named, a helical or a volute spring; and also a modification of the mode of attaching the apparatus to the foot, which would require drawings to make them clear.

This apparatus, as described by the patentee, has been the result of long and painful experiment on his part, and has been gradually brought to its present improved form, for the relief of his own sufferings. Without it he would not be able to walk, not even by the aid of the best instruments for the purpose previously constructed; but by means of his own improvements, he is enabled to move about with considerable facility.

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26. For a machine for *Making Posts and Fences from Clay;* Mercy Wright, Tullytown, Bucks county, Pennsylvania, May 15.

At each end of a suitable frame, provided with two sets of rails, or tracks, for the passing of a car, there is a revolving platform, with rails corresponding with those on the frame. A car, the upper part of which contains, or is formed into, a mould, runs upon the rails; and by means of cogged wheels which take into a rack, attached to the under side of said car, it is drawn under a roller which compresses the clay into the mould, and then under a scraper which takes off the surplus clay. When the car reaches the platform at one end, the mould is removed, the platform turned, and the car passed on towards the opposite platform, where the mould is again filled with clay, and the whole operation repeated.

Claim.—"What I claim therein, and desire to secure by letters patent, is the manner in which I have constructed, combined, and arranged the machine for the purpose of moulding and pressing brick clay, so as to form the parts of fences, as set forth; that is to say, I claim the manner in which I have combined the two revolving platforms, the railways, the car with its moulds, and the roller and scraper, substantially as set forth, so that said parts shall co-operate in effecting the object of their construction."

This machine, it appears, is the contrivance of a female, and we wish that its utility was equal to the skill with which its parts are arranged; but we cannot believe that posts made of brick clay, having mortises in them, and that rails of the same material, fitting into said mortises, will ever be used to surround and divide a plantation. The material will be too fragile, however well it may be baked, and would be liable to break down under the man who should attempt to climb it.

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27. For an improvement in the machine for *Extracting Stumps of Trees,* and for removing buildings; Luke F. Cavanaugh, Newfield, Tomkins county, New York, May 15.

"The nature of my invention consists in arranging a strong screw in a perpendicular position in a suitable frame, to the head of which screw is attached a sweep, or lever, moved by animal, or other, power, and by which the screw is turned in a movable nut, on which an inclined movable bar rests, and to which the chain, made fast to the stump, is attached, so that as said nut rises on the screw, the end of the bar also rises, and the stump is drawn from the ground; said frame being placed on a carriage of four wheels, for the purpose of moving it from place to place."

"What I claim as my invention, and desire to secure by letters patent, is the bed piece and movable bar, in combination with the screw nut and carriage, as described."

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28. For an improvement in the *Straw Cutter;* John B. King, Athens, McMinn county, Tennessee, May 15.

The knife which cuts the straw, in this machine, is hung at each end to a crank; the shaft of each crank having a fly wheel, and a band wheel, with a band passing from one to the other, for the purpose of causing the two cranks to revolve at the same time.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of hanging the knife on two pivots that are placed in the two cranks, each having a separate fly wheel attached to it, which balance wheels receive a simultaneous motion, produced by means of two drums that are coupled together by a band."

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29. For an improvement in the process for *Removing Wool and Hair from the Skins of Animals;* Francis and Hanson Robinson, Wilmington, Delaware, May 15.

"We do not claim the use of any particular apparatus for carrying the same into effect, but employ such instruments and means as are now known and used for other purposes; but what we do claim, and desire to secure by letters patent, is the process of loosening the wool, or hair, from skins, or hides, by the direct application of steam thereto; said skins, or hides, being suspended in any suitable room, or apartment, into which steam can be admitted."

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30. For an improvement in the construction of *Pumps;* William M. Wheeler, Liberty, Clay county, Missouri, May 15.

The lower part of the barrel of this pump is of much greater diameter than the upper, and the piston is made to fit into both; that part fitting the small barrel is made hollow, and is provided with a valve at its upper end, where it is connected with the piston rod. When the piston is drawn up it acts as a lifting pump, the water flowing in to fill up the vacuum in the lower, or larger, part of the barrel, and this, on the descent of the piston, is forced up through the hollow piston into the small barrel; and as the lower barrel is of greater diameter than the upper, the water received in it during the descent of the piston, will more than fill the small barrel, and hence the water will be forced out at the top.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the barrel with an enlargement below, and having a plunger with an aperture in its centre, adapted to said enlargement, in combination with a hollow piston, or stem, attached to said plunger, and passing up through a portion of the smaller diameter of the pump barrel, having a valve at its upper end to close the aperture in it, through which the water mounts on the descent of the plunger, by which arrangement the apparatus is constituted a lifting, as well as a forcing, pump; in other words, what I claim is constructing the apparatus in such a manner that on every descent of the piston rod a vacuum, or space containing no water, is formed in the pump above the plunger, the object of which is to admit a sufficient quantity of water on every ascent of the piston rod, to keep a constant stream flowing at the discharging pipe, as described."

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31. For an improvement in the manner of making the *Joints of Clothes Horses;* Harvey Luther, Providence, Rhode Island, May 15.

The above named patent is for a method of making the hinges by which the frames of clothes horses, called by the patentee clothes stands, are united. The side pieces of each frame are made round, and the two that are to be hinged together have a groove around them, near the top and bottom, the groove being deep enough to receive a cord, or chain, which passes around one of them, is then crossed, passes around the other, and is fastened on the inside.

The patentee says—"I am aware that clothes stands, &c., have been hinged by means of cords, or straps, attached to square rods, so as to allow them to fold in either direction, and I do not, therefore, claim this as my invention, but what I do claim, and desire to secure by letters patent, is the peculiar manner in which I make the hinges, that is to say, I claim the making the rods constituting the frames which come together, with grooves in them, in combination with the method of uniting them by means of cords, or chains, in the grooves, as described."

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32. For improvements in *Horizontal Wing Piano Fortes;* Frederick C. Reichenback, Philadelphia, Pennsylvania, May 19.

The claim is to the "manner of constructing and arranging the wrest pin block, and the wrest pins, so that the latter shall pass entirely through the former, and receive the wires at their lower projecting ends;" and also to the "manner of constructing, arranging and combining wrought iron braces with the wrest plank and straining board, said braces passing over the wrest pin block, bearing against its back edge, and resting at their rear ends on the straining pin plate."

33. For an improvement in the *Recumbent, or Library, Chair;* Henry P. Kennedy, Philadelphia, Pennsylvania, May 19.

The improvement above named is in that kind of recumbent chairs in which the seat slides in the frame, and is clearly indicated in the following claim, viz:—"What I claim as my invention, and desire to secure by letters patent, is the combination of a spiral spring, or springs, with the rails and sliding seat of a recumbent chair, which will allow the seat to be forced forward, and the back to assume a reclining posture, and which will restore the seat and back to their ordinary position when the force is removed, as described."

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34. For improvements in the machine for *Moulding and Pressing Bricks;* Waldren Beach and Ephraim Lukens, Baltimore, Maryland, May 22.

In this machine the moulds are arranged in a horizontal wheel, and pass under a hopper, from which they receive the tempered clay; they then pass under a pressing roller, which is in connexion with the hopper, its sides embracing that portion of the roller which presses the clay. As the moulds advance they pass under a knife, which is hung to an arbor and is pressed upon by a spring, which knife cuts off the surplus clay, whilst it yields, in the event of meeting with a stone. A projection from the under surface of the pistons that form the bottom of the moulds, is acted upon by an inclined plane that forces the bricks out of the moulds, and then as the wheel continues to rotate, the bricks are, by means of a guide, delivered on to a belt, by which they are carried off to any desired place of delivery. After the moulds have been emptied, they pass under a rotary sieve to be sanded, and thence to the hopper. The filling of the moulds is effected by two pallets, called by the patentee cams, each of which is hung to a shaft that passes across the lower part of the hopper, and through its side, and is there connected with a weighted lever, which lever projects from the shaft in the same direction with the pallet. The axes of these pallets being above the surface of the mould wheel, the weighted levers will cause their extreme ends to bear on the surface of the wheel, and as the moulds pass under, the clay is forced into them by the inclined surface of the pallets. The axles of the pallets are provided on one side with a knife to cut off the clay to the proper width.

Claim.—"What we claim as our invention and improvement, and which we desire to secure by letters patent, is—First. The rotating horizontal wheel, in combination with the duster. Second—The box, or casing, round the bottom of the pressing roller, in combination with the horizontal wheel and hopper, in the manner set forth. Third—The combination of the horizontal wheel with the cams in the bottom of the hopper, the said cams having attached to them a knife inside the hopper, and a weight, or lever, outside of the same. And fourth—We claim also the manner of combining the pressing roller with the hopper, in the manner described, viz: by arranging the said roller on the outside of the hopper, and connecting it with the same, by means of the casing surrounding said roller, as set forth."

35. For an improvement in the *Churn;* Enos Mitchell, Pittston, Kennebec county, Maine, May 22.

This churn has double dashers, which are to be operated upon by two bent levers.

The claim is to the "method of combining the two dashers of the churn by means of the two bent levers, and the connecting rod, operated by the arm on the rock shaft."

36. For improvements in the manner of operating the *Cotton Gin:* David Phillips, Georgetown, Mercer county, Pennsylvania, May 22.

The frame of this cotton gin is placed on wheels, and is called by the patentee a car body. The wheels run on a circular rail, the body being supported by a beam projecting from a vertical shaft, that has its bearings in the centre of the platform, to which the circular rail is attached, and in a frame above. The forward wheel is to guide the car, or gin, body, and the hinder is to operate the gin, by means of a large belt wheel attached to, and turning with it, which is connected with the roller, or cylinder, of the gin by a belt.

Claim.—"I claim, as my invention, the car body described, so constructed as to receive the seed and clean cotton, in combination with the supporting and guide wheels, arranged and operating substantially as described."

37. For *Maintaining Power* to drive machinery; Stephen P. W. Douglass, Williamson, Wayne county, New York, May 22.

The object of this machine is to receive and regulate any irregular, or intermitting, power obtained from any source, and to give it out regularly, as may be required. Two endless chains, placed side by side, are each passed around two wheels, placed one above the other. A pinion, attached to a suitable sliding frame, is situated between the two chains, with its teeth taking into their links; and to this sliding frame is suspended a heavy weight. The irregular, or intermitting, force is applied to the shaft of one of the wheels, acting on either of the chains, which, by its operation on the pinion, winds up the weight. provided the other chain be held permanent, but as this weight tends to turn this chain, one of its wheels is connected with, and actuates, any machine requiring to be moved with regularity. If the power applied be equal to that given out, the pinion, with its weight, will remain in the same position, and will simply transmit the power which it receives; but if the former exceeds the latter, the pinion and weight will be raised, and when the former becomes less, then they will sink. In this way it will be seen that the winding up of the weight does not prevent it from giving out its full force, as it is always suspended to the chain which gives out the power.

Claim.—"What I claim as new, and desire to secure by letters patent, is the manner in which the two endless chains are arranged, and connected, and are combined with the respective wheels, or pinions, and with the weight to be raised, and with the machinery to be propelled, so as to obtain a regular propelling force, either from an intermitting motive power, or from a continuous irregular power, as herein described."

38. For an improvement in *Files for Filing Newspapers, &c.*, called the "Movable Binder;" Isaac Detterer, Philadelphia, Pennsylvania, May 22.

This movable binder consists of two sides of a book cover, and to the back edge of one of which two screws are attached, that pass through two holes in the other cover; the papers, pamphlets, &c., to be filed, or held between the covers, are placed between them, and by means of two handles, provided with screw nuts, the whole is held together. The handles are split, and spring apart, like crayon holders, and have a slide to close them, their inner ends being provided with threads to fit the screws.

Claim.—"I claim, as my invention, the combination of the book cover, the screws, and the movable handles, for the purpose of binding and unbinding, at pleasure, letters, newspapers, music, &c.

39. For an instrument for taking measure of the body, preparatory to cutting coats, called the *Tailors' Measure;* Lyman B. and Ellery Miller, Middletown, Orange county, New York, May 29.

The patentees say, "We are aware that there are a number of measuring instruments consisting of elastic strips of metal, and which are attached to the person whose measure is to be taken; we do not, therefore, make any claim to the individual parts of our instrument. But we do claim the combining of four strips of metal, which are to stand horizontally when the instrument is in use, with four others which are to stand vertically, the whole of which slips are made adjustable by means of sliding sockets, and have one measuring tape attached to them."

The left hand vertical strip is placed in the middle of the back, and its upper end is provided with a strap that passes around the neck; the second at the back of the shoulder, the third in front of the shoulder, and the fourth in the middle of the breast. The lower horizontal strip passes around the waist, the second under the arms, (the end of each of these being provided with a strap to pass entirely around the body,) the third extends from the middle of the back to the shoulder. to measure the extreme width of the back, and the fourth passes over the shoulder and unites the upper ends of the second and third vertical straps. A strap is attached at the junction of the second horizontal and the third vertical strip.

40. For an improvement in the *Wind-Mill;* William Zimmerman, Stephenson, Rock Island county, Illinois, May 29.

This patent was obtained for a mode of regulating the inclination of the sails, as the wind increases or decreases, by means of "the centrifugal governor." The sails of the wind-mill are all connected with a disk, at one end of a sliding rod, which rod passes through the centre of the shaft of the sail wheel, it being made hollow for that purpose; the end of the sliding rod opposite to the disk is provided with a rack, said rack being acted upon by a pinion that receives its motion from the slide of the governor. The increased velocity of the wind wheel will throw out the balls of the governor, which, by their connexion with the sails by means of the sliding rod and disk, increases their inclination, and thus lessens the action of the wind upon them, and consequently retards the motion of the mill.

Claim.—"What I claim therein as of my invention, and desire to secure by letters patent, is the weathering of the sails by the action of the sliding rod, or piston, and the disk, operated upon by the governor substantially in the manner set forth, whether said disk be made to operate upon the sails by means of the rods, by racks and pinions, or by any other device which is the same in principle, and producing a like effect, by means substantially the same."

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41. For an improvement in the *Counter Twist Speeder;* Jesse Whitehead, Manchester, Chesterfield county, Virginia, May 29.

"The nature of my invention and improvement consists in the application of the revolving block, or driving drum, directly to the metallic guide which is placed in front of the twisting belts, or bands, for twisting the roping, which is delivered as it passes through the guide directly against the block, and near the centre thereof, horizontally, and conveyed from thence between the guide and block to the bobbin placed above the block, and in contact therewith—the said guide being grooved, or channeled, along its concave side to admit the roping, for the purpose of keeping it in its compressed state, as it leaves the twisting belts."

"What I claim as my invention, and desire to secure by letters patent, is the before described mode of delivering the twisted roving in the compressed state in which it leaves the twisting bands at a uniform and regular tension, by means of the aforesaid combination and arrangement of guide, block, and bobbin. I also claim the construction of the metallic curved and channeled guide, as described."

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42. For improvements in the machine for *Riving and Shaving Shingles;* William S. George, Baltimore, Maryland, May 29.

"The timber from which the shingles are to be made by my machine, is to be cut of the proper length, and rived out so as to constitute square bolts, of such size as shall adapt them to the width of the shingles to be formed from them. These bolts are to be placed in a frame prepared to receive them; a piece of the proper thickness for a shingle is then rived off by means of a reciprocating knife, which piece falls upon a table below the riving knife, whence it is driven forward between two dressing knives, which, as it passes between them, are made to approach towards each other in such manner as to give a regular taper to the shingle, the edges being jointed at the same time, by jointing irons duly fixed for that purpose."

The knife that rives the shingle is attached to a sliding frame with two tables, one of them forward of the knife to gauge the thickness of the shingle to be rived, and the other level with the top surface of the knife, to support the block. The shingle is then forced between two sets of knives, the one set being permanent for dressing the edges, and the other set for shaving the surfaces, which are so arranged as to approach each other as the shingle passes through, to taper it.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have combined and arranged the frame for holding the bolts with the vibrating frame, its panels, and riving knife, so as to rive shingles from the bolt, as described. I also claim the within described manner of constructing and combining the dressing and jointing apparatus, the dressing knives being made to approach other, and the jointing frames being affixed and operating substantially as above described."

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43. For a mode of *Treeing Boots;* Elias Hall, Jr., Spencer, Worcester county, Massachusetts, May 29.

The boot tree, after the boot is placed upon it, is put upon a bench properly adapted to it, and the rub-stick is connected with a lever, or sweep, by a swivel, or hinge joint, so as to allow it to take any required position, whilst the lever, or sweep, to which it is attached, can only move up and down, and vibrate to and fro. The upper end of this lever is connected with a standard by a rod attached to said standard, and sliding in a slot, the end of the rod being enlarged and fitting in a hole bored in the end of said lever, such hole being of greater diameter than the width of the slot, so that the lever, with the rub-stick, may slide up and down, and be retained by the enlargement on the end of the rod.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the rub-stick with the sweep in the manner described, said sweep having a swivel joint and a hinge joint, to allow the rub-stick to adapt itself to the inequalities of the boot. Also the method of combining the sweep and rub-stick with the standard by means of the rod, having a boll on its end, adapted to a groove, or slot, on the upper end of the sweep, as set forth."

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44. For an improvement in the *Press for Compressing Hay, Cotton, &c.;* Charles W. Hawkes, Brunswick, Maine, May 29.

The follower of this press is operated by racks and pinions in the usual manner; but the racks, there being two of them, are attached to uprights that work on the outside of the box, and are connected with the follower by a cross beam which extends from one upright to the other.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which the racks are combined with the follower of the press, by being attached to the uprights outside of the box, and connected with each other, and with the follower of the press, by the cross beam."

45. For an improvement in the *Pump;* Sidney S. Hogle, Lansingburgh, Rensselaer county, New York, May 29.

In the barrel of this pump there are two pistons, the rod of one passing through the other, so that as one piston descends the other rises, and vice versa, by which a constant stream of water, which passes through a valve in the upper piston when it descends, is kept up. The two pistons are operated by means of two spiral fillets, or grooves, called by the patentee cams, or eccentric grooves, made in a vertical drum, or enlarged part of a shaft, which act upon rollers on the ends of the piston rods.

Claim.—"What I claim as my invention is the combination of the suction and lifting pistons so as to produce an alternate action, as described, by means of the shaft constructed with cams, or eccentric grooves, and the rollers attached to the head of each piston rod, as described."

46. For an improvement in the *Tobacco Press;* Thomas G. Hardesty, Tracey's Landing, Ann Arundel county, Maryland, May 29.

"In my improved tobacco press, the hogshead in which the tobacco is to be pressed has both heads removed, and it is placed horizontally upon the frame of the press, resting upon two long, longitudinal pieces of timber near the ground, prepared to receive it; and two false hogsheads, or receiving cylinders, the same in diameter, or nearly so, with the hogshead, are placed upon the same longitudinal pieces in a line with it, said hogshead being situated between them. The hogshead and the two false hogsheads are to be filled with tobacco by hand, and may be made to contain the whole quantity that is required to be packed in the hogshead. When thus prepared, pressure is to be made at each end of the apparatus, by means of two screws, which force up two followers, said followers entering and passing through the false hogsheads, and forcing all the tobacco which had been placed in them for that purpose, into the hogshead situated between them. The false hogsheads are so constructed as to admit of their being removed from the press without its being necessary to retract the pressing screw; and this I effect by uniting the staves which constitute the false hogsheads to bands, or hoops, of iron, which are clasped together at their ends, and when unclasped, are to spring open sufficiently far to admit of the escape of the false hogsheads over the shaft of the screw."

"What I claim, and desire to secure by letters patent, is the manner in which I construct and employ the two false hogsheads by placing them horizontally in a range with the hogshead to be packed, and pressing simultaneously from each end, as set forth. I also claim the so arranging of the parts of the press, as that two followers may be forced up, one from each end thereof, by means of the pressing screws operated by female screws, or boxes, attached to the power wheels."

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47. For an improvement in the manner of constructing *Saw Mills;* Jeremiah Rohrer, Rohrersville, Washington county, Maryland, May 29.

In this improved mill there is one roller above, and another below the stuff which is being sawed, for the purpose of supporting it, this being necessary in sawing light stuff. The upper roller has its bearings in a piece of timber, which is hinged to another piece that slides in a suitable frame above the log. The hinged piece, with its roller, is so hung that it will yield only when the carriage runs back, but not when it is moving towards the saw. The roller may be removed from the log by means of a cord, which passes over a pulley and extends within reach of the tender of the mill. The lower end of the sliding piece, in which the lower roller has its bearings, rests upon a second sliding piece, which is jointed to a lever, to draw it away and allow the roller to slide down, the upper end of which lever is acted upon by the carriage, when the saw approaches the end of the stuff, and thus allows the saw to cut through the end of the stuff.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the two rollers for making pressure upon the upper and lower parts of a log, when being sawed in a saw mill. I am aware that a single roller has been used for supporting a log, but this has not been made to operate in the manner described by me, nor do I know, or believe, that there has previously existed any combination similar to that herein described, by which two rollers were made to co-operate in sustaining the stuff. I do not claim, therefore, the employment of a single roller under the log; but I do claim the manner in which I have made the lower roller to operate, by causing the same to rise and fall vertically, and to be made self-operating when it is to be removed from under the log, the respective parts thereof being constructed and arranged in the manner set forth, and being used in combination with the upper roller as described."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent granted to ROSS WINANS, *for an improvement in the mode of Regulating the Waste Steam in Locomotive Engines, November 26th,* 1840.

To all whom it may concern: be it known that I, Ross Winans, civil engineer, of the city of Baltimore, in the state of Maryland, have invented an improvement in the manner of constructing locomotive engines, by which improvement the action of the waste steam may be so regulated as to increase or diminish the draught of the furnace, at pleasure, whilst the engine is in operation and the locomotive under way; and I do hereby declare that the following is a full and explicit description thereof:

In the locomotive steam engine, as ordinarily constructed, the steam, after it has performed its office in the cylinders, is, under the name of waste steam, conducted through pipes, denominated waste pipes, into the chimney of the engine, and is suffered to escape from these pipes in a vertical direction, so as greatly to increase the natural draught through the fire, and thereby to augment the quantity of steam produced. It is a matter of great importance, however, in the arrangement of the engine, to be able to regulate the amount of this increased draught, so as to increase or diminish the power of the engine according to the various circumstances to which it is subjected when in use. It is obvious, for example, that to take a loaded train of cars up an ascending grade, requires more power than is necessary to propel it along a level, and that in a descending grade it is frequently desirable that the power should be diminished; there are other circumstances, also, as is well known to every competent engineer, under which the ability to regulate the power of the engine is not only desirable, but of vast importance.

The force with which the steam will escape from the orifices of the waste pipes, into the chimney, is determined by the elasticity of the steam, and the size of the orifices of the escape pipes; and by being able to change the latter, the velocity with which the steam shall issue may be determined, and with this, also, the augmentation, or diminution, of the draught, will be regulated. In the construction of this part of the engine, as heretofore made, it has been the aim of the builder so to proportion the size of the orifice of the waste pipes, as that the steam shall issue from them with what may be denominated a medium velocity; which, however, under the same elasticity, could not be varied, as the orifices were to remain of the same determinate size.

Now, my invention consists in a contrivance by which the engineer is enabled—in those engines in which the draught is increased by the discharge of the exhaust steam into the chimney, and while the engine is in motion—to increase or to diminish the draught in the chimney, at pleasure, by enlarging or contracting the orifice of the pipes there, so as to adapt the draught to the occasion, regulating the head of steam generated to the particular exigency.

In the engine in common use, the escape pipes, by which the steam passes from the cylinders into the chimney, are contracted in size at their upper ends, forming the orifice herein mentioned. In my invention, I propose to give them an uniform diameter throughout, say three or four inches, according to circumstances, as shown in the accompanying drawing. Where A and B, fig. 1, represent the escape pipes, and C the chimney of a locomotive, in each of these pipes I place an inverted cone, *o*, *o*, made of metal, the upper end of which terminates in a cylinder, the diameter of which cylinder is so adjusted, with reference to the diameter of the escape pipe, as to allow between them, when the cone and cylinder are in the escape pipe, as small a space for the escape of the steam as is at any time allowable, so that when the cone and cylinder, which, for brevity, I term a damper, is in the position represented in the drawing, fig. 1, the steam passes into the chimney with the greatest velocity, and the draught is the greatest. It will be seen at once, by inspection of the drawing, that when the damper is raised, a part of the cone less in diameter is brought in a horizontal line with the top of the escape pipe, and the opening for the steam to pass into the chimney is increased, and that in proportion as the damper is raised, until, when the point of the damper is lifted to a line with the top of the pipe, the escape of the steam into the chimney is unrestrained by it, and of course the least increase of natural draught is obtained.

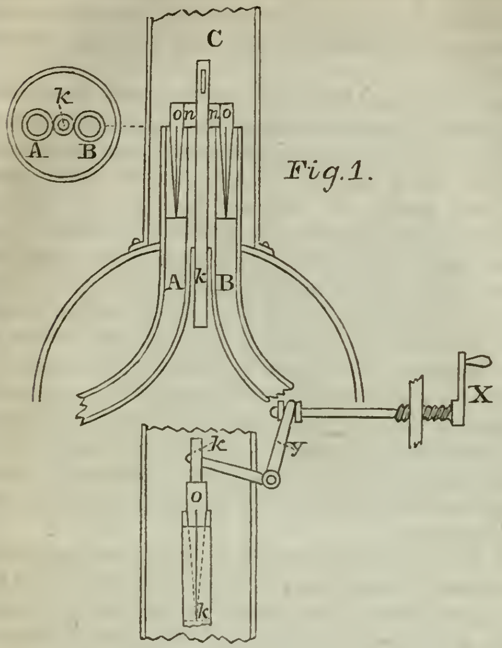
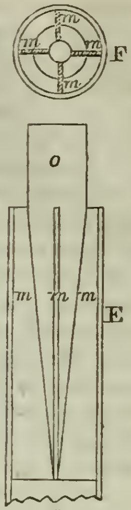
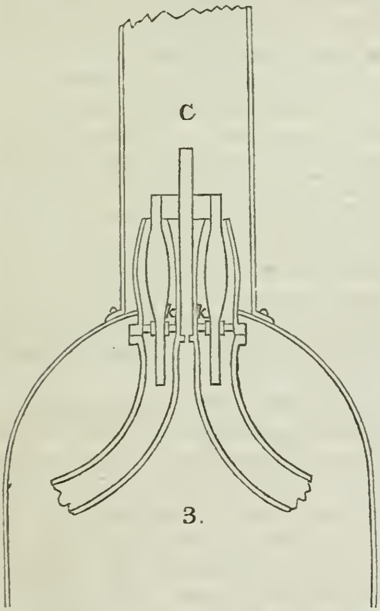


Fig.1.


2.

A contrivance by which the engineman can, at his pleasure, raise or lower the dampers, will enable him, therefore, to open or contract the orifices of the pipes, and, consequently, to regulate the draught according to the particular emergency. This may be effected in various ways well known to machinists. One that would answer the purpose is exhibited in fig. 1, where the engineman, by turning the winch X, moves the bent lever *y*, which, in its turn, raises, or sinks, the damper *o*. In order to steady the dampers, and keep them properly adjusted in the pipes, I affix three or four wings to each damper, extending from the apex to the base of the cone; these wings, which consist of thin plates, stand in the direction of the radii of the horizontal section of the cone, and their outer edges touch the inside of the pipe. They are represented at *m*, *m*, in the drawing, fig. 2. To make the motion of the dampers simultaneous in both pipes, their upper, or cylindrical, portions, are connected, by extending one of the wings up the adjacent sides of said portions, so that one of the wings is common to the two dampers, as at *n*, *n*, fig. 1. Further to steady and guide the said dampers, a rod may be made to pass between the two pipes, so as to slide within a tube placed there for the purpose, as shown in fig. 1, at *k*; to the upper part of which rod, one of the arms of the bent lever already mentioned may be attached, by means of which, the dampers may be raised or lowered. D, fig. 1, is a plan showing the pipes and the tube between them, without the dampers. E, fig. 2, is a representation of the pipe enlarged, with the damper in it. F is a plan of the pipe enlarged, showing the damper and its flanches.



3.

Fig. 3 exhibits a section of a chimney, and two exhaust pipes, showing another modification of my contrivance for producing the same result. The dampers here, instead of being inverted cones, are in such a form as to operate like direct cones, and the opening between them, and the sides of the pipe, instead of being the smallest that is allowable, when the dampers are depressed, is the largest; and it is by raising, not by sinking, the dampers, that the opening is decreased, and the draught increased. In fig. 3, the dampers, in place of being steadied in the pipes by flanches, as in fig. 1, are shown as steadied by a prolongation of the rod to which the bent lever is attached, downward, through a hole in a piece of metal, which is placed for that purpose, in the pipe, below the damper, as at *k*, it being so formed as to serve as a guide to the said rod, as already observed. There may be many contrivances for opening and closing the orifice of the pipes, beside the two above described; these two, however, will answer the purpose, and illustrate my object.

I do not claim the plan of increasing the natural draught, by causing the steam from the cylinders to enter the chimney, through diminished orifices; but I do claim as my invention, desiring to secure the same by letters patent, the plan of increasing or diminishing the force with which the steam from the cylinders enters the chimney, at the pleasure of the engineman, while the engine is in use, or motion, by enlarging or contracting the orifices of the escape pipes, increasing or diminishing thereby, at pleasure, the draught of the chimney, in the manner above set forth—not intending, by this claim, to limit myself to the precise arrangement of the respective parts, as herein described, but to vary the same, as I may think proper, whilst I attain the same end, by means substantially the same.

Ross Winans.

Practical & Theoretical Mechanics & Chemistry.

Theory of Saponification.

Aware of the importance of investigating the theories involved in the chemical arts, with a view to their ultimate improvement on scientific principles, we had formed the design of imbodying the later observations of chemists on the oily substances, when an essay of Prof. Liebig's appeared in the "Annalen der Chemie and Pharmacie," for March, 1841, which contains an excellent view of the theory of saponification; we, therefore, translate the essay, nearly entire.

J. C. B. and M. H. B.

What was known of the nature of saponification, previous to the commencement of the present century, amounted to nothing, excepting the important discovery, by Scheele, of the *sugar of fats*, now called the *hydrated oxide of glyceryl*, (glycerule.) Chevreul began, in 1813, a series of investigations on soaps, which have not only thrown a clear light on this portion of chemistry, but have also led the way to the most brilliant discoveries in the whole province of organic chemistry. We are indebted to him for the present predominating principle in all organic researches, viz: to subject a body to a series of changes, and to ground its composition on the ascertained connexion of these changes.

Chevreul proved that all fats comprehended under the terms grease, oil, and tallow, consist of three materials united in the most varied proportions, one of which, *oleine*, at common temperatures, and below 32° Fahr., is always fluid, the others solid, the one called *stearine*, the other *margarine*—distinguished from each other by their melting points, and the different acids they give rise to by decomposition. These fatty substances are each composed of a peculiar fat acid, united to a compound oxide, the oxide of glyceryl, and being salts, are subject to decomposition, like ordinary salts.

Decomposition ensues when a fat, i. e. a compound of oxide of glyceryl, is treated with an alcali, or with oxide of lead or zinc; the alcalies, or metallic oxide, combining with the fat acid—the former constituting soluble salts, or soap; the latter insoluble salts, or plasters. The oxide of glyceryl, at the moment of its separation from the fat acids, takes up water and forms hydrated oxide of glyceryl.

The weight of the hydrate of glyceryl, added to that of the hydrated fat acids, amounts to more than the weight of the fat employed; the increased weight arising from the water entering into combination with the glyceryl and fat acids.

In the saponification of fats by alcalies, no other products are formed, and the operation is conducted equally well in vacuo, or in the air. With strong alcaline lyes, the soap separates from the concentrated fluid, and collects on its surface, while the glyceryl remains dissolved in the alcaline solution. The soap remains dissolved in a weak and hot alcaline lye, but on cooling, the whole congeals to a gelatinous, translucent mass.

Soaps are *solid and hard*, or *soft*. The last are obtained from drying oils, and contain potassa as a base, and to give them more consistence, tallow and fat oils are added, which form solid soaps. The hard soaps contain soda, and are prepared with fat oils, tallow, &c.

Soda soaps are made in England and France directly by soda and fats, in Germany by decomposing potash soaps with chloride of sodium. Commercial soaps from vegetable fats consist of oleated and margarated alcalies; those from animal fats are salts of stearic, margaric and oleic acids, with an alcaline base.

Potassa and soda soaps are readily soluble in hot water and alcahol; the addition of a quantity of water to the aqueous solution produces a precipitation, the neutral salts of stearic and margaric acids decomposing into free alcali, which remains in solution and acid steorate and margarate of alcali, which precipitates in form of pearly crystaline scales.

Potassa soaps are more soluble in water than those containing soda. Stearate of soda may be regarded as the type of hard soaps, and when in contact with ten times as much water, it suffers no striking change. Stearate of potassa forms a thick paste with the same quantity of water. Oleate of soda is soluble in ten parts of water; the oleate of potassa dissolves in four parts, and forms a jelly with two parts, and possesses such a strong affinity for water, that 100 parts absorb 162 in a moist atmosphere. Margaric acid acts similarly to stearic. It follows from this that soaps are soft in proportion to the oleates, and hard in proportion to the stearates and margarates they contain. Soda soap exhibits a peculiar behaviour to a solution of common salt; it loses the power of being penetrated by, or dissolving in, a solution of salt of a certain strength, and this remarkable action is an important condition in its manufacture, on which depends the separation of all free alcali and oxide of glyceryl, its content of water, and the state in which it is brought into the market.

If a piece of common hard soap, cut into pieces, be put into a saturated solution of salt, at ordinary temperatures, it swims upon the surface without being moistened, and if heated to boiling, it separates without foam into gelatinous flocculæ, which collect on the surface, and upon cooling unite into a solid mass, from which the solution flows off, like water from fat. If the flocculæ be taken out of the hot fluid, they congeal, on cooling, into an opaque mass, which may be pressed between the fingers into fine laminæ, without adhering to them. If the solution be not quite saturated, the soap then takes up a certain quantity of water, and the flocculæ separate through the fluid in boiling. But even when the water contains $\frac{1}{400}$ of common salt, boiling produces no solution.

If the soap be boiled in a dilute and alcaline solution of salt, and suffered to cool, it again collects on the fluid in a more or less solid state, depending on the greater or less concentration of the solution, i. e., on the quantity of water taken up by the soap. By boiling the dilute salt solution with soap for a considerable time, the watery flocculæ swell up, and the mixture assumes a foaming appearance; but still they are not dissolved, for the solution separates from them. The flocculæ, however, have become soft and pasty even after cooling, and their clamminess depends more or less upon the quantity of water they have taken up. By still continued boiling this character again changes, and in proportion as the water evaporating renders the solution more concentrated, the latter again extracts the water from the flocculæ; the liquid continues to foam, but the bubbles are larger. At length a point is attained when the solution becomes saturated; before this, large, iridescent bubbles are observed to form, and in a short time all foam disappears; the liquid continues boiling without foam, all the soap collects in a translucent mass on the surface, and now the solution and soap cease to attract water from each other. If the plastic soap be now removed and cooled, while the solution is pressed out, it has become so solid as scarcely to receive an impression from the fingers. In this state it is called *grain-soap,* (Kernseife.)

The addition of salt, or its solution, to a concentrated alcaline solution of soap in water, precipitates the soap in gelatinous flocculæ, and the mixture behaves precisely like solid soap boiled with a dilute solution of salt. Carbonated and caustic potassa act exactly like salt, by separating soap from the alcaline fluid, in which it is absolutely insoluble.

The application of the above to the manufacture of soap is evident. The fat is kept boiling in an alcaline lye until all pasty matter disappears, but the lye should only have a certain strength, so that the soap may be perfectly dissolved in it. Thus tallow may be boiled for days in a caustic potassa-lye, of spec. grav. 1.25, without saponifying; if the lye be stronger, a partial saponification takes place, but being insoluble in the fluid, it floats upon the surface in solid mass: by the gradual addition of water and continued boiling, at a certain point the mass suddenly becomes thick and clammy, and with more water a kind of emulsion is formed, (Seifenleim,) which continued heating renders perfectly clear and transparent, if a sufficient quantity of alcali be present. In this state it may be drawn into long threads, which, on cooling, either remain transparent, or are more milky and gelatinous. As long as the hot mass suffered to drop from a spatula exhibits a cloudiness, or opalescence, the boiling is continued, or more alcali added. When excess of alcali is present, the cloudiness arises from imperfect saponification, or want of water; the former is shown by dissolving a little in pure water, which becomes perfectly clear when the whole is saponified; if the lye contain lime, the mixture is also clouded, but the addition of carbonated alcali instantly clarifies it.

In order to separate the soap from water, free alcali, and oxide of glyceryl, a large quantity of salt is gradually added to the boiling mass, on each addition waiting until it is dissolved; the first addition increases the consistency of the mass, while each successive portion renders it more fluid, till it loses its threading character, and drops from the spatula in short thick lumps. As soon as the congelation is complete, i. e., when gelatinous flocculæ separate from a clear watery liquid, the fire is extinguished, the soap suffered to collect on the surface, and cooled either on the liquid, or ladled out, and suffered to get solid.

In the former case it is impure from water, free alcali, and other impurities of the lye, and is therefore illy adapted for commerce, although sufficiently good for domestic purposes. As in other chemical operations, a precipitate is purified by boiling it in a fluid in which it is insoluble, so soap is purified by a solution of salt rendered alcaline.

The soap of the first boiling is either re-dissolved in weak alcaline lye, and precipitated by salt several times, or it is boiled with an alcaline solution of salt several times, by which means it is rendered much purer. When the saponified fluid is made with potassa, the salt (chloride of sodium) operates in a two-fold manner: it dissolves in the pasty liquid, and decomposes with the potassa salts of the fat acids, forming on the one side chloride of potassium, and on the other soda, or soda-soap. That a decomposition takes place is evident from the altered consistency of the fluid mass. Since chloride of potassium has not the property of separating soda soap, a larger quantity of salt is added. When potassa-lye is employed in soap making, the first salting requires more than twice the quantity of salt.

In the preparation of potash soaps, a concentrated potassa lye is employed for separating the soap. Acetate, or tartrate of potassa, may be employed on a small scale. In the manufacture of soaps, the saponification of the fats is not completed by the first treatment with weak lyes; and the subsequent repetition of fresh lyes, beside purifying, also renders saponification more perfect.

In saponifying olive and other oils, the mixture often attaches itself to the bottom of the vessel, and is burned; in these cases the alcaline lye is previously mingled with salt, so that the forming soap is obtained in a state of fine division, and yet prevented from forming a perfect solution. For common house use, soap of the first boil is only treated once with salt; that for commercial purposes is suffered to swell up in a weak salt lye, by means of which it takes up fifteen to twenty per cent. water. Grain soap (Kernseife of the Germans) is generally colored bluish, or greenish, from sulphuret of iron, or copper, or from iron, or copper-soaps. By cooling, these coloring matters collect more or less in certain points, which gives a marbled appearance to the hard soap. Marbling is generally produced by the addition of sulphate of iron, or peroxide of iron, to the still soft mass.

For white soap, it is rendered fluid by heating it in a saline, alcaline lye, and kept in the covered vessel until all the coloring matters have subsided. The more water the soap has taken up in this operation, the more perfect the separation of the impurities, the whiter the soap. Now, since this water is not separated, but sold in the soap, it follows that it has much less real value than the grain soap. The white soap contains from forty-five to seventy, marbled soap from twenty-five to thirty-five per cent. water.

The manufacture of soft soap is the simplest of all. The drying oils, either alone, or mixed with train oil, tallow and other fats, are kept boiling with dilute potassa lye until the saponification is completed, i. e., a mass is formed which draws into long transparent threads. Particular care is had in its preparation to the dilution of the lye, for all soft soaps are insoluble in moderately strong potassa lye, and may be precipitated from their solution by the addition of strong lyes. The fluid would therefore appear cloudy, milky, with an excess of strong lye, and by adding water would become pasty, or gelatinous. A deficiency of alcali produces an acid oleate of potassa, which attaches itself in thick masses to the bottom of the vessel; but an addition of lye changes it into a neutral salt. Oxide of glyceryl is not separated from soap, although it might be done by the final use of strong alcaline lyes.

The soft soaps of commerce have a greenish, or greenish brown color; they are transparent in thin laminæ, shining, soft but not fatty to the touch, of a peculiar odor, and have an alcaline re-action. Tallow is often added to them, which disseminates crystaline particles of stearate of potassa; communicating to them a peculiar grained character. Chevreul and Thenard found in commercial soft soap 39.2 to 44 per cent. oleic and margaric acids, 8.8 to 9.5 potassa, and 46.5 to 52 water. They always contain hydrated oxide of glyceryl and delphinate of potassa, derived from train oil, whence their peculiar odor.

When an alcaline soap is mingled with an earthy, or metallic, salt, voluminous white, or colored precipitates ensue, in which the alcali is replaced by the earth, or metallic oxide. Thus the salts of lime, magnesia, &c., throw down lime, magnesia, &c., soaps. Hence the curdling appearance, when soap is used with hard waters, arises from the union of the lime, or magnesia, they contain, with the fat acids. If carbonate of lime be in the water, it may be thrown down by a little caustic potassa, or lime, which will render it softer; if sulphate of lime, or a magnesia salt, be present, pearlash (ash-lye) will separate the earths.

TO THE EDITORS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on Mr. Samuel Seaward's Remarks on Auxiliary Steam Power.

Gentlemen:—I have a few observations to offer upon Mr. Samuel Seaward's paper, abstracted from the Transactions, British Engineers, inserted in your valuable Journal for December, 1841, and in the American Repertory for December, 1841, which will shew how necessary it is to examine, and to separate the theoretical remarks from the facts in that paper.

At page 412, vol. ii, 3rd series, Journal Franklin Institute, Mr. Seaward remarks, "A quadruple increase of power will not produce double the original velocity of a steam ship, although in theory such is assumed to be the case, for as the weight is more than doubled, the immersed section becomes greater, and a still further increase of power becomes necessary."

In this quotation, obscure though it be, it does not in the least appear that Mr. Seaward intended to say, that quadruple power will be insufficient to produce double the original velocity in a steam ship having the same immersion; but on the contrary, he supposes that quadruple power was sufficient, yet in the table calculated by Mr. Cubitt, and appended to Mr. Seaward's paper, it is assumed throughout, that eight times the power is required to produce double velocity in a steam ship, having the same constant immersion.

Thus in one quotation, four times the power, and in the other quotation eight times the power, is assumed to be necessary to produce a similar effect.

As this question is important, and can so easily be mechanically determined by experiment, it is very singular it should remain undetermined, as it is the fruitful parent of many absurdities, and surely none can be greater than one lately advanced, namely, that the resistance to vessels moving in water increases as the square of the velocities, but the power requisite to overcome that resistance, increases as the cube. Such contradictory statements, however eminent their authors, cannot be deemed either luminous, instructive or creditable.

Presuming your wish is to uproot error, and to increase the sum of knowledge, I beg to offer you the following experiments, to set this subject at rest.

Having at hand a small, but broad, cistern, I caused two short and heavy model boats to be drawn through the water by different weights attached to threads, passing under and over appropriate pullies, and found that when one boat had passed over a certain space, the other boat, drawn by a double weight, had passed over double space—or over double the space the first boat had passed over, in the same time; and I found corresponding effects produced when lighter, or heavier, weights (similarly proportioned) were employed.

As in all these cases the double weights descended double distances in the same time, double weight, multiplied by double descent, was equal to the expenditure of quadruple power for double velocity of the model boat.

These experiments having been very rudely questioned, because made on a small scale, I repeated them in a larger, but narrower, cistern, when at first I was surprised to find that 2.25 times the weight was required to draw one of the boats through double the space, that was required to draw the other boat in the same time, thus 4.5 times the power was required to obtain double velocity in a narrow cistern.

The extra resistance I soon found was occasioned solely by the undue accumulation of water in front of the fastest boat, for on substituting narrower boats in the narrow cistern, a weight of $2\frac{1}{8}$ was sufficient to produce double velocity of one boat in a narrow cistern, and on repeating the experiments in an open pond of water, where, by the use of lines upon drums of different diameters, supported upon elevated frames, so that the descent of the weights through one foot, drew the boats through four feet, the extended results thus obtained, corresponded with those at first obtained in the wide cistern, namely, the descent of a double weight through a double space, caused the one boat to travel through twice the distance the other did, in the same time.

These experiments, then, prove alike, that quadruple power is required, and that quadruple power only is required to produce double velocity in a boat in open water, and also proves that double speed is twice as costly, and only twice as costly, as single speed, for an equal distance, in any vessel maintaining the same degree of immersion; because though four times the power is expended in a given time, yet the speed being doubled in that time, the actual power expended is but doubled also, because the quadruple expenditure of power is of only half the duration of the single expenditure.

The same results are obtained in another form, in the following experiments:—

A pair of paddle wheels were formed of tin plate, twelve and a half inches in diameter, on an iron axis two feet long, one half inch turned bearings to ditto, and a wooden drum, two inches diameter, thereon.

Each wheel (having sixteen floats, four inches long, by one and a half inches deep,) was immersed in water about two inches, and the wheels were then made to revolve by a cord, one end of which was wound on the drum, and the other end of the cord passed over a pulley suspended to the roof of a building.

When different weights were attached to the cord, the descent of each weight from the pully to the floor of the building, caused the paddle wheels to revolve a constant number of times, at different speeds, the times occupied by the different weights in their descent was ascertained by the oscillations of a pendulum.

Descent of weights during oscillations observed:

Of 2 lbs.,	67
4 lbs.,	+33
8 lbs.,	+16
16 lbs.,	+ 8

Thus in all those cases, double weights descending through double space, or quadruple power, caused the paddle wheels to revolve with double velocity in a uniform depth of water.

Could any farther evidence be required, that double velocity of a steam ship is acquired by the expenditure of quadruple power, it is to be found in the diagram of the Great Western steamer, vol. ii, page 274, of the American Repertory, and in the table and details thereof, pages 406 to 408 of the same volume, to which the writer has appended the following remark, and with a quotation thereof will conclude the present communication:—

"We ought to consider it a very fortunate circumstance that the steam engine has become its own commentator, we thus obtain certain facts unalloyed by prejudices or conceits, a concurrence as rare as valuable." I. F.

Brooklyn, N. Y., May 31*st*, 1842.

Remarks on Evaporation in, and Incrustation of, Steam Boilers.

Mr. C. W. Williams has read a paper before the Victoria Gallery, Manchester, upon the evaporation in, and incrustation of, boilers, in which he has endeavored to show that the destruction of the plates by the fire is not caused by the saline, or other permanent, incrustations, but by the muddy deposits which settle after the ebullition is over.

To prove this he exhibited experiments, showing that the incrustations were nearly as good conductors of heat as the metal of which the boilers are made, but that the muddy deposits are non conductors, and argues that as the incrustations will transmit the heat nearly as fast as the metal, that therefore they cannot cause its destruction. It does not appear that this conclusion is well founded, because although plates of iron, of usual thickness, will transmit the heat from the fire to the water as fast as generated, it does not follow that the same power exists when the plate is increased to an undue thickness. Suppose a boiler constructed of two or more plates, rivetted together—which would be a parallel case to a plate lined with one or more layers of incrustation—the effect would be, as is known from experience, to destroy the outer plate. What engineer has not seen the effect of a patch over the fire, when the internal plate has not been cut through, to admit the water to the inner surface of the new piece? We would scarcely advise engineers to depend upon the theory of Mr. Williams, in this particular, but to keep the boilers well freed from sediments of all kinds.

Mr. W. made some judicious remarks upon the necessity of keeping the plate always in close contact with water. He instanced a case where the water had been prevented from touching the plate by violent ebullition, and presented a sample taken from the water leg of the steamer Liverpool. The leg, though situated in the lower part of the boiler, between the furnaces, was so narrow that the heat from the adjacent fires drove the water entirely from between the plates, so that when an aperture was made steam only escaped. This is a fact of great importance, showing the necessity of making the passage, or leg, between the furnaces, of sufficient width to ensure a full supply of water. For the purpose of obtaining an enlarged grate surface, engineers are but too apt to contract the intermediate space and thereby incur a great risk of destruction to the leg sheets. It is, probably, one of the causes of the more rapid decay in the legs of our river and sea boats, than in any other part of the boiler.

The Liverpool's furnaces were four feet seven inches long, and five feet three inches deep; and the leg was a simple passage between them, probably not more than four inches wide, and when an intense fire existed, there was not sufficient space for the free circulation of the water. Four, or four and a half, inches, would have given ample space for the outer leg, to which the heat comes in contact only on one side; but the middle legs should not have been less than seven or eight inches in width.

Notice of Porter & Co.'s Patent Anchors.

Through the politeness of our London Correspondent, we have been favored with a copy of a pamphlet, issued by Porter & Co., of Dunston Iron Works, near *Newcastle-on-Tyne*, descriptive of the results of a number of practical tests to which their *patent anchors* have been subjected, by various officers of the Royal Navy, by pilots on the Coast of England, and by other mariners. From this pamphlet we shall extract the substance, for the information of our readers.

Few instruments now in use can justly lay claim to such high antiquity as the anchor; it clearly antedates the Christian era, and its origin is in fact so very ancient, as to be deeply involved in obscurity, though we believe its invention has usually been ascribed to the Tuscans.

The anchor, nearly in the same form as that in which it is at this day used, has been for ages employed; and although numerous attempts have, from time to time, been made to improve it, their practical success has not been great, and its general shape has remained almost unaltered; though within the last twenty years—since the general introduction of chain cables for shipping—it has been made shorter and stouter than formerly, whilst the stocks of chain anchors are usually made of iron, and so secured, by a forelock, that they can at pleasure be turned parallel to the shank, when the anchor is stowed inboard. On the other hand, when cables of hemp were more generally used, the stocks were fixed in their position, and formed of wood.

The year 1822 seems to have been prolific of inventions designed for the improvement of anchors—at least four distinct patents having passed the great seal of England, in that year, for various alterations in the form and mode of constructing them; of these, three had revolving flukes, and in one of the forms, patented by William Piper,* the flukes turn upon a bolt passing through the crown, as is the case with those we are about to describe, and, like them, the proper angle was to have been given to the entering fluke, by the revolution of the other, until its point, or bill, closed upon the shank, as in the *patent anchor* of Porter & Co.; (see fig. 3,) but as the latter is differently stocked—though identical in the principle of its fluke action—it is sufficiently distinct in form to be classed as a separate invention; besides, Porter & Co. have the merit (not, we believe possessed by the other,) of having brought their anchor into successful practical use, by freely submitting it to the test of actual experience at sea, under almost all the circumstances which commonly affect an anchorage: this test the anchor in question seems to have borne in a manner very satisfactory to the seamen by whom it was used.

Lieut. Rodgers, of the Royal Navy, and many other ingenious men, have at various times exerted their inventive talents in bringing forward new forms, or methods, of constructing anchors, but thus far without having superseded, to any great extent in practice, the ordinary form with which every one is familiar; whether the *patent anchor* of Porter & Co. will meet with the same fate as its predecessors, is a question which time and experience can alone determine; all that the latter yet justifies us in declaring is, that *it fairly promises* to become a valuable substitute for the common anchor, especially in the naval service.

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* London Journal of Science and the Arts, (Newton's) vol. v, page 248.

As it is unnecessary for our present purpose to enter into farther detail upon this subject, we will now proceed to speak more particularly of the *patent anchor* of Porter & Co., referring to their descriptive pamphlet as our text.

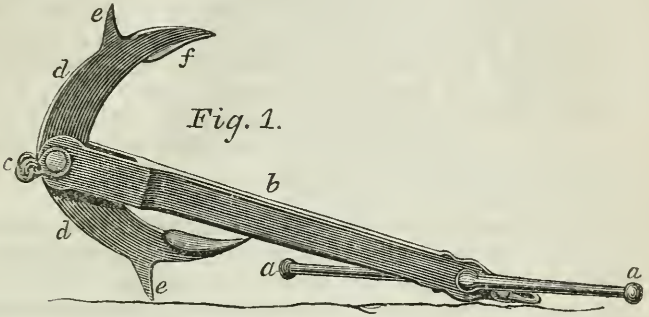
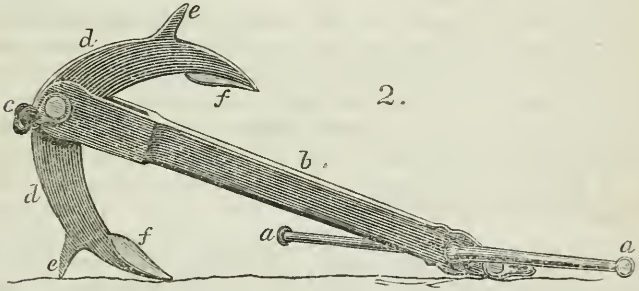


Fig. 1.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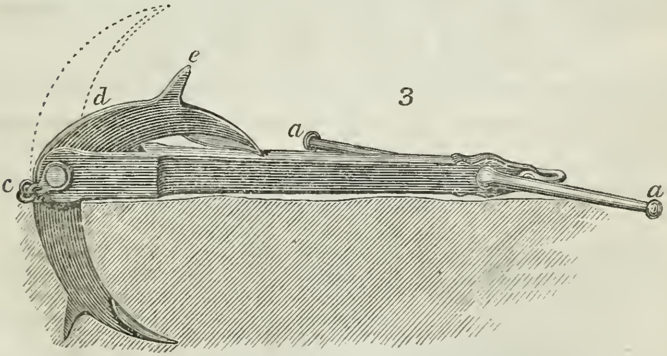
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Fig. 1, represents the *patent anchor*, as it would probably rest upon the bottom, when first let go from a vessel.

Fig. 2, represents the position which the *patent anchor* would take at the first check it received from the cable.

Fig. 3, represents the position which the *patent anchor* would assume, in good holding ground, when fully strained by the cable.

We will here remark, in connexion with the illustrative cuts, that the spurs, *e*, *e*, (fig. 2, &c.) seem indispensable to the successful action of the *patent anchor*, as without them, if the joint at the crown, *c*, should happen to be stiffened by rust, or any other cause, the anchor might readily slide along on the back of the fluke *d*, and come home without taking hold of the ground at all.

But it must be evident that this cannot happen when the spur *e* is attached to the fluke, for, from the weight of the anchor itself, as well as the shape of the toggle, or spur, it would immediately enter, or seize hold of, the ground; and the instant the cable was tightened, by the drift of the ship, the lower fluke would evidently revolve upon the spur *e*, as a pivot, and assume the position shown in fig. 2; *once in that position*, the bill of the lower fluke would enter, (if the ground admitted,) and a further draught upon the cable would bring the anchor into the position exhibited by fig. 3, in which it would remain, if the holding ground was good.

In all the illustrative cuts, the same letters refer to the same parts, and it may be well to remark, that the anchors represented are made wholly of *wrought iron*, forged in the best manner.

a, *a*, the stock; *b*, the shank; *c*, the crown; *d*, the flukes; *e*, the spurs, or toggles; *f*, the palms.

From documents quoted in the descriptive pamphlet of Porter & Co., it appears that a common anchor (on Pering's plan)—of the usual quality manufactured in the dockyards of the Royal Navy, for a first rate line of battle ship—and several of the *patent anchors*, were, in the presence of many distinguished officers, submitted, successively, to a breaking strain, by means of the powerful hydraulic proving machine, in Woolwich Dockyard. Of these trials of strength, the results are compiled in the following table.

Description of the anchor tried.	Weight of anchor in pounds	Strain imposed in tons.	Deflection in inches at point of fluke.	Regular admiralty proof in tons.	Breaking wei't of anchor in tons.	Ratio of weight of anchor to breaking weig't	Remarks.
1. Common anchor, of a 120 gun ship.	10847	60	2¾	66	68	1-1 4	Steady pull.
		66¾	4½				
		68	Unknown				
2. Porter's patent.	3136	14	Unknown	27	60½	1-43	Steady pull.
		20	⅞				
		27⅛	Unknown				
		60½	Unknown				
3. Porter's patent.	616	20½	Unknown	8⅝	20½	1-74	Steady pull.
4. Porter's patent.	560	21½	Unknown	8¼	21½	1-86	Strain by jerks.
5. Porter's patent.	381	17	Unknown	5⅝	17	1-100	Steady pull.
6. Porter's patent.	620	27	Unknown	9	27	1-97	Steady pull.

It further appears, by our text, that Porter & Co.'s *patent anchors* have been more or less used in the Royal Navy for nearly three years, and that by order of the Lords Commissioners of the Admiralty, some *forty-five sail* of vessels belonging to the British navy, have recently been equipped with these *patent anchors*.

Previous to taking this step, however, the Admiralty, in the year 1841, pursuant to a request made of them by Porter & Co, caused *patent anchors* (at the risk and expense of the patentees) to be simultaneously placed on board of some ten or twelve sail of her Majesty's cruisers, employed upon the coasts of England; and they instructed the commanders of these vessels to test the new anchors, in every possible manner, and report the results, *after three months actual service.*

The reports made under the orders alluded to, by these officers of the Royal Navy, concerning their anchorage with the *patent anchors,* in almost every kind of holding ground, *were uniformly favorable;* and to avoid repetition, we will here subjoin but three of these, (addressed by permission to the patentees,) viz: *one* from Commander Denham, R. N., and *two* from Mr. Thomas, a master in the navy, commanding H. M. surveying ship, the *Mastiff.*

Marine Surveyor's Department,
Port Fleetwood, Jan. 1, 1842.

Having had under trial, Porter's Patent Anchors, and subjected them to the most treacherous holding ground, great tidal jerks, and effect of eddies, as well as working round by steam paddle, *to foul them if I could;* I am now enabled to state that anchors so constructed will present to the mariner the combined essentials so long looked for. I need only enumerate the following:

It is almost impossible to foul it.

It bites quickly into the most stubborn ground.

It holds on to the shortest stay-peak.

It cannot well lodge on its stock end.

It presents no *upper* fluke to injure the vessel herself, or others, in shoal water.

It cannot injure vessels' bows when hanging a cock-bill, as merchant vessels find a convenient practice.

It is not so likely to break off an arm, or part in the shank, as anchors with fixed flukes do, because the construction of these arms can be of continuous rod iron, and the leverage is so much nearer the ring, owing to the pea of the upper fluke closing upon the shank.

It is a most convenient anchor for stowing in-board on a voyage, as the flukes can be easily separated, and passed into the hold; it can as easily be transported by *two* boats, when one would be distressed with the whole weight.

It produces the desired effect of ground tackle, at less weight.

Wishing it *general adoption,*
I remain yours truly,
H. M. Denham, Com. R. N., F. R. S.
Consulting Marine Surveyor.

Her Majesty's Surveying Ship "Mastiff,"
Woolwich, February 18, 1842.

Gentlemen—I received your letter of the 12th January, enclosing another from the Lords Commissioners of the Admiralty, authorizing me to give an opinion of the merits of your Patent Anchors, which have, by their sanction, been put on board her Majesty's ship under my command, for trial, between the year 1839 and the present time; in order to do which, it will be necessary to detail all the circumstances attending them from the time they were embarked.

In 1839 your anchor, which was put on board, weighed only 8 cwt. 1 quarter, when the *Mastiff's* small bower anchor weighed 13 cwt.; with this discrepancy, added to a little prejudice in favor of our old forlorn hope, rendered me incapable of reasoning myself into the belief that your anchor was strong enough in the crown to hold the ship, or that it would bite the ground so quick as recent experience has taught me. Impressed with these ideas, and the ship being employed in a survey of the Orkney Islands, where she is compelled to anchor in narrow and intricate channels, in strong tides and eddies, surrounded by dangers, your anchor, gentlemen, was reserved for trying its merits in a wider space, where there was room to retreat in safety should it break: an opportunity offered of so doing on the 28th of November in the same year, when it was let go in 12 fathoms water, off Aldborough, with Orford Lighthouses in one; there was a fresh breeze, and considerable sea running at the time; by the time 29 fathoms of cable had been veered out, to our astonishment and agreeable surprise, the ship brought up and swung to the tide, when 60 fathoms of cable was given her; on the return of the weather tide, the ship was pitching her bows under water, and the wind had freshened, so much so, that with the force of forty men some difficulty was found to heave the ship a-head to stay a peak, yet this small anchor tenaciously held its gripe, until the topsails were filled, with the view of either breaking it or tearing it from its bed; we succeeded in doing the latter, and hove it up to the bows, not as we anticipated, with both flukes gone, but in good order, covered with mud and clay to the stock. This *first trial* did away with my former prejudice against it, and led me to apply for a larger anchor for trial; my application was met by you, gentlemen, putting on board, in the Frith of Forth, one of your Patent Anchors of 13 cwt., which was immediately taken to the bows, in lieu of one of the ship's bowers, and applied to use, the merits of which you will receive in my next letter.

I am, gentlemen, &c.
GEO. THOMAS, R. N.,
Master Commanding, and Marine Surveyor.

Her Majesty's Surveying Ship "Mastiff,"
Woolwich, February 23, 1842.

GENTLEMEN—Your Patent Anchor, weighing 13 cwt., which was received on board her Majesty's ship under my command, for trial, in April, 1820, was put into use the day it was embarked; it was let go in six fathoms water, off St. David's, in the Frith of Forth, and, by the time that 12 fathoms of cable was veered out, the ship was brought up, and the clasping of the upper fluke to the shank, was sensibly felt on board. At the expiration of three days an attempt was made to weigh it, but it had buried itself so deep in the mud, that, after heaving-to short a-peak, we were compelled to wait the rising of the tide to drag it from its bed; it was subsequently used until the month of November in the same year, in various parts of the Orkney Islands, the ship anchoring every day on soils of mud, sand, stones, and a compound of the three; in no one instance did she drift or foul her anchor, nor was any precaution taken to prevent her so doing, but quite the reverse. Its unqualified merits and superiority, over all other anchors, was reported to the Lords Commissioners of the Admiralty. On our return to Woolwich, the above anchor was put on board her Majesty's ship *Albert*, at the request of Captain Trotter, to be used on her voyage to the Niger. In my next I shall relate to you, gentlemen, the merits of your Patent Anchor put on board this ship, for trial, in 1841.

I am, gentlemen, &c.
Geo. Thomas, R. N.,
Master Commanding, and Marine Surveyor.

In addition to *sixteen* officers of the Royal Navy, as many masters of merchantmen, together with the pilots of the port of Deal, have all united to bear a favorable testimony to the valuable properties possessed by the anchors in question—all of these mariners having either ridden by them in their own vessels, or witnessed their successful holding in gales of wind, under a variety of circumstances. *The bulk of this evidence is, therefore, experimental.*

Porter & Co. have certainly brought forward a most forcible mass of important testimony in favor of their *patent anchors*, yet still there are a few objections, which may with propriety be urged against them.

Thus Captain John Washington, R. N, says:—"Were I to seek for objections, they would be, first, that the anchor supplied to the *Shearwater* was not easy to fish; this the patentee, by his recent improvement of placing a shackle on the lower part of the shank, has, I trust, completely remedied. Secondly, that in case of loss without a buoy-rope (which steamers never use,) it is very difficult to sweep. Thirdly, that letting go the anchor on a rocky bottom, it seems possible, *but improbable*, that the cheeks, or "lugs," of the shank, might strike a rock, and appearing the weaker part, snap; but this also has, I understand, been remedied."

To these objections we may add, that, from the testimony of Mr. Thomas, the commander of the *Mastiff*, given in the letters already quoted, it appears that under some circumstances, *these anchors hold too well.*

Some persons may smile at such an objection as this, but it must be recollected that *in the merchant service* the crews are usually small—that merchantmen cannot afford to leave their best bowers wherever it is necessary to anchor by them—that it is almost as requisite that an anchor should admit of being weighed with ease, as that it should hold well when down—in short, it seems that in cases like those stated by the Commander of the *Mastiff*—where he was obliged, in one instance, to fill his topsails for the purpose of loosening a small bower anchor (of Porter & Co.'s patent) from the ground, after heaving upon it in vain with *forty men;* and in another, after bringing the anchor short a-peak, * to await the rising of the tide, to break it out—

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* That is, bringing the cable perpendicular from the anchor to the bows of the ship.

a merchant ship, *manned as usual*, would, probably, have been unable to get her anchor at all, on either of the occasions referred to. Now if this be not a real objection, we submit to those acquainted with nautical affairs, whether, at the least, *this very tenacious holding* will not sometimes be productive of great inconvenience.

Captain Washington's objection, that the *patent anchor* "*is very difficult to sweep*," is a pretty strong one, for it is well known that many anchors have been recovered in this way, which would otherwise have been totally lost. The common anchor, when fixed in the bottom, has always one fluke projecting upwards; this affords great facilities in the operation of sweeping, which is generally so successful that it is actually followed as a business, by persons upon our seaboard, who may every summer be seen sweeping at random the exposed roadsteads along the Atlantic coasts, in which operation so many lost anchors are caught, as to make it frequently *a very profitable business:* a glance at Fig. 3, will show, that whenever the upper fluke has closed down upon the shank, an attempt to sweep the *patent anchor*, by the usual process with the bight of a hawser, *would be almost hopeless.*

Again it appears to us, that the additional surface exposed to oxidation by the *patent anchor*, at the junction of the shank and flukes, and the probable wearing and breaking of the fluke bolt at the crown from frequent use, are likely to be objectionable.

We must not, however, omit to notice—what the experiments above recited already prove—namely, that the *patent anchor* gains much strength from being in two separate pieces, as it admits of being forged in a compact and solid manner, and avoids the great practical difficulty in the common anchor of successfully welding the shank and flukes together, at the crown, *in such a manner as to be safe;* almost all the common anchors are unavoidably weak in this part, and it is a high merit in the *patent anchors* that, unlike the others, no practical objections exist to their being as well and solidly made as the material will admit.

In conclusion, we feel bound to observe, that the advantages promised by the *patent anchor*—as reported upon by the British naval officers—so far outweigh any objections which occur to us at this time, that we cordially recommend it to the consideration of our merchants—of the mariners in their service—*and, especially, we commend it to the attention of the superior officers of the navy of the United States.*

The Meteorological Table is omitted for want of room, but will appear in the next number.

JOURNAL
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AUGUST, 1842.

Civil Engineering.

Facts and Observations on Four and Six Wheel Engines.
By JOHN HERAPATH, ESQ.

[CONTINUED FROM PAGE 20.]

Hull and Selby Railway.

By some means, the documents from which the following account is drawn, have for several weeks been overlooked.

After leaving the Manchester and Leeds Railway, I bent my course towards Hull. I have in another place, made a few observations on this railway, which, therefore, I have no necessity to repeat here.

Generally, this line is laid upon *kyanized longitudinal bearings*, but in one or two places there are cross-sleepers. The rails upon the longitudinal bearings are 44 lbs., but I did not learn what they were upon the cross-sleepers; I think about 70 or 75 lbs.

I asked Mr. Gray, the ingenious superintendent of the locomotives. how the kyanizing succeeded, and he told me he understood very well. I was anxious to know this, as I had upon another line heard some whispers against it.

I left Leeds on Monday, Nov. 29, for the purpose of proceeding to Hull, on the *Ariel* engine, which is fitted with Gray's patent expansive apparatus. This is an apparatus for cutting off the steam at almost any part of the stroke one desires, and changing that part at pleasure, by which means the engine may be adapted to almost any power required, and any velocity. Of this very ingenious invention, I shall say more hereafter, the inventor, Mr. John Gray—the gentleman before mentioned as the locomotive superintendent of the Hull and Selby line—having kindly presented me with a brass model to explain what my natural dulness did not permit me readily to comprehend, when I was with him at Hull. Meanwhile I may mention, that there seems among the engineers to whom I have spoken about the invention, to be but one opinion as to its economical utility, and what has been not a little gratifying to my personal vanity, they have admitted that, though they were satisfied with the efficiency of the invention, they found great difficulty in learning its *modus operandi*, which proves that the heads of some of the engineers are as dull as mine.

The *Ariel* engine, I believe, belongs to the York and North Midland Company, and being made for a gauge of 4 feet 8½ inches, and, I think, rather loose in her axles, she appeared to be very unsteady, and twisted about much in going over that part of the North Midland Railway, from Leeds, which has a 4 feet 9 inch gauge, but afterwards she improved. Upon the *Ariel* I rode to the junction of the York and North Midland with the Leeds and Selby Railway, and then got upon the *Wellington*, of course a York and North Midland engine, as the Company leases the Leeds and Selby line. She was a very steady engine.

What this Leeds and Selby line was, I am unable to say, but it appears now to be a substantial and good line, having very nearly the character of the Hull and Selby Railway, which is a continuation of it; but if I recollect aright, for I did not take a note of it, the rails of the Leeds and Selby are laid upon stone blocks.

At Selby I got upon the *Liverpool*, one of the Hull and Selby Company's engines—another fitted with Gray's expansive apparatus.

Both the *Ariel* and the *Liverpool* were six wheel engines, and had 6 feet driving wheels, and 2 feet stroke, a proportion to which, Mr. Gray is, for some reason unknown to me, much attached; the former worked at 70 lbs. pressure, and the latter at 75. The *Liverpool* appeared to me to be a good engine, and performed well. I was informed that both she and the *Ariel* consumed but 18 lbs. of coke to the mile.

But to return to our engine and the driver; poor fellow, he had the misfortune to stammer, and had much difficulty, amid the noise of the air and engine, to make me understand him. However, if he had difficulty here, he was resolved to convince me that with Gray's apparatus, his engine had none of her motions. He flew along at a rapid rate, and as the road was so straight, and the engine a steady one, I considered my neck—to the safety of which I am rather attached—in no danger, and therefore enjoyed it very much.

This man spoke in the warmest terms of Gray's machinery, and, certainly, from what I saw him do with the engine, it manifested great capability. On my remarking, at one time, upon the power of the engine, he rejoined, "Yes, sir, and I can snap that coupling (that between the engine and the tender) at any time. Shall I do it now? I will if I shall." I have no doubt that he would, but as I imagined there might be a possibility at the same time of uncoupling me from the engine, and bringing me into closer contact with the ground, and perhaps with the wheel of the tender, than I had any anxiety for, I replied, "I am satisfied with your word, and have no wish to put you to the trouble of proving it."

The next day I went some distance up the line from Hull, upon the *Star* engine, with Mr. Gray, and returned upon the *Collingwood.* In returning upon the last engine, I observed she was unsteady, and inclined to pitch at low velocities, but lost it all at high. This, I have very little doubt, was owing to the position of the coupling link, as I have found it upon other lines.

This engine had a contrivance for lifting the trailing-wheels off the ground, for the purpose of giving more bite to the driving wheels; and it appears from a statement hereafter given by Mr. Gray, that this is applied to other engines of the Company, though but seldom used.

The average pressure of the steam in the engines worked by Mr. Gray's apparatus, appears to be about 75 lbs.

I was glad to see upon this line the third class passengers accommodated with seats, and to hear that the second class carriages are to have doors with glass panes in them.

The length of this line is 30¾ miles, and of the Leeds and Selby. 24¼. The passengers who go to York, do it in 51 miles, not including about 2 miles of ground which at present they have to travel over twice, for the purpose of going to a station and uniting with another train. To London from Hull, by railway, is 243 miles. Their rate of traveling by the mail on the Hull and Selby, is about 21 miles an hour, including stoppages.

The Company's stock of locomotives, in the middle of December, consisted of 12 engines, and two more nearly off the stocks, coupled in four wheels. Of this stock they have generally from eight to ten in an efficient state. In December they had nine. All their driving wheels have flanches. The average gross load during the first twelve months, including engine and tender, is stated to be 68 tons.

Two crank axles only have broken—one after running ten weeks, and the other at the Hull station. They were uncoupled, and of course both six wheel engines, (the Company have none else,) and the accidents happened in both cases at points from faulty axles, the welding being "about seven-eighths unsound." Not the slightest injury or inconvenience happened to any one. The engine in the second case had no load, and in the first, kept the rails and brought her train home.

There has been no instance of an engine running off the rails, or "anything like it."

The engines are all six wheel, and cost about £1,375; their extreme length is 19 feet 8 inches; height of centre of gravity supposed to be 4 feet, and in the smaller engines 3¾ feet; distance of extreme axles. 10 to 11 feet; height of middle of boiler, 5 feet 7 inches, and 6 feet; diameter of driving-wheels 5½ and 6 feet, of the other wheels 3½ feet, of cylinder 12 inches generally, one 14, and 2 coupled 16; stroke, some 18, some 24 inches. The average consumption of coke was 0.53 lbs. per ton per mile on the gross load, which by alterations was reduced to, 0.44, and with Mr. Gray's patent apparatus, to 0.32 lbs.; the corresponding gallons of water evaporated were 27½, 19⅓, and 15¾. The steam pressure is screwed down to from 60 to 80 lbs. I believe the latter applies to the engines with Gray's expansive apparatus. The age of their best and worst engines is about 12 and 20 months. The total number of miles run in the first year was 135,000, or an average for each engine of 11,250, and expense per mile run 9d. Each running engine makes two double trips a day, or 124 miles.

With respect to the two kinds of engines, four and six wheel, and their peculiar motions, the following is an abstract of Mr. Gray's replies to the questions in my circular.

He prefers six wheel engines for economy of fuel, steadiness of motion, ease, durability, and less injury to the road. He says they have a little of each kind of motion, peculiar to locomotives, combined in their smaller engines, and less in their larger. With light pulling on straight lines, and especially descending, these motions are most conspicuous. The outside bearings of six wheel engines, he says, "undoubtedly give greater steadiness." He asserts that it is not the imperfections of the road which are the primary cause of the sinuous, pitching, or rolling motions, but that the sinuous "generates the rocking, and, in a slight degree, the pitching as well, however good the road may be;" that their "steadiest engines are their tallest, and this unusual result arises from great length in the front and hind axles." The springs are "rather longer, and a little more elastic (flexible) than usual." "The motions of our larger engines," he observes, "the nearer the centre of the axle the cranks are the better, but there being some other combining causes, it is difficult to say definitely what belongs to each."

The following summary, furnished me by Mr. Gray, will, at the same time that it developes his views on certain points, supply some interesting information not in the previous outline.

"Our engines have each six wheels, but six of them are prepared to lift the hind wheels from the rails, when a deficiency of adhesion is experienced; however, finding their pitching and serpentine motions considerably increased when upon four wheels, we never use them in that state with passenger trains, and but rarely with anything else. All their weight rests upon outside bearings.

"The other six are constantly six wheeled engines, (not being prepared to lift the hind wheels;) all the weight upon the front and hind shafts rests on outside bearings, and have, in consequence, the extensive base for the springs of eleven by six and a half feet, whilst they have inside bearings for the crank axle, and only two inside stay frames, steps, and springs, with all the weight on the crank resting inside of the wheels; thus the advantages of stability in six wheeled engines are secured, and also the chief merit of the London and Birmingham four wheeled engines, in a greater simplicity, and protection to the crank axle, is also obtained.

"The two coupled engines have outside bearings for the front axle, but only inside bearings for the crank and hind axles.

"The weight is 14¾ and 15¼ tons respectively; the weight of the coupled engines is not known yet. The weight of the driving wheels of the former is generally about seven tons.

"The first six engines have about 4¾ tons on the front axle, and the other six about 6¼ tons, leaving for the former about three tons, and on the latter about two tons upon the hind axle.

J. Gray."

In a conversation I had with Mr. Gray, he said he thought four wheel engines would be as safe as six, if they were as long between the axles, and had outside bearings.

On this railway I had another opportunity of witnessing a similar accident to that which I witnessed on the Manchester and Leeds Railway. Tuesday morning, on my going to the station, I found the Liverpool engine—the one I had rode on the preceding afternoon—had come in, I think nineteen miles, tail first, with her left eccentric strap broken, by which means she had, of course, only her right cylinder to work with. Here, as in the case on the Manchester and Leeds, the flanches of the left wheels, both hind and fore, and the driving too a little, bore evident symptoms of having been much rubbed against the rails, while the right wheels' flanches had apparently not touched the rails. I pointed out this to Mr. Gray, and mentioned to him the very similar thing I had witnessed on the Manchester and Leeds Railway; but he seemed to think it was more due to the axles being out of square, than to the action of one cylinder; and after my return to town, he wrote to me, saying that he had had the axles measured diagonally, and found "they are a little out of square, inclining the engine to run to the same side where the flanches were observed to be most worn."

I readily present my readers with Mr. Gray's views upon this subject, at the same time begging to observe that I have not yet made up my mind, either from facts or scientific investigation, of what is the true explanation of the phenomena observed.

In the early part of this article I have hinted at some curious facts mentioned to me by Mr. Gray, *relative to longitudinal bearings and cross-sleepers.* The difference of draught in hoar frost and wet weather, Mr. Gray affirmed—and the affirmation was borne out by the testimony of one or two of their men, to whom I spoke on the subject—*was as much as 50 or more per cent. against longitudinal bearings,* the draught being so much greater upon them than it was upon cross sleepers. For instance, they assured me that oftentimes when the engine could with difficulty draw its load upon a level, over longitudinal bearings, it would trip up easily enough a rise, which they called their "bank,"of 14 or 16 feet a mile, in which the rails were laid upon cross-sleepers.

To me, at first, this was a poser, the solution of which I could not so much as guess at. Being, however, informed that the hoar frost seized the rails on the longitudinal bearings earlier, and left them much later, than it did those on cross-sleepers, I immediately divined the cause, and saw a beautiful, because an altogether unexpected, illustration of the truths of natural philosophy. It is known to philosophers, that before dew can be deposited on any body, this body must become colder than the atmosphere around it, and that hoar frost is nothing but dew, frozen by the temperature of the body on which it is, having sunk below the freezing point, that is, below 32° of Fahr.

It is also known, that the temperature of the earth, a little distance below the surface, is, at night, generally higher than that of the atmosphere. Wood is comparatively a non-conductor of heat. Therefore, and because the rails, where there are cross-sleepers, are imbedded in the ballast to within an inch or two of the top of the rail, and iron is a good conductor of heat, whatever heat the rails lose by radiation, on account of their rough surface, is quickly and wholly, or in a great measure, supplied from the sub-soil, where there are cross-sleepers, while it is not so where the rails are kept from a communication with the subjacent ground, by the broad and deep wood of the longitudinal bearings. The consequence is, that the rails on the longitudinal bearings lose more heat, and faster, and of course become colder earlier, and continue so longer, than those on cross-sleepers. Of course the deposited moisture from the atmosphere is earlier and more copiously condensed, and quicker and harder frozen, upon those than upon these. Hence the whole phenomena of heavier draught, arising from longer and greater slipperiness, upon the longitudinals, and, perhaps, at times of their being slippery when the cross-sleepers are wholly dry, and free from hoar frost.

As a confirmation of this, I may here mention what I observed Tuesday morning, Dec. 21st, upon the Bristol and Exeter Railway. It had been a calm and clear night, for the whole surface of the vegetable country was covered with a thick and hard hoar frost, which can take place in such circumstances only; and the stagnant water was everywhere covered with a thick coat of ice. The rails themselves were so covered with hoar frost, that we were obliged to have the assistance of a pilot engine; and yet with all the united power of two Great Western engines, our speed was comparatively slow. Being upon the platform of the engine, my attention was quickly caught by here and there perceiving patches on the rails, of one to one and a half feet, or perhaps more, perfectly dry and free from hoar frost, amidst the all but universal white which prevailed. Struck with the phenomenon, I looked more closely for something which might develop the cause, and soon saw that these exceptions to the hoar frost invariably appeared over the places where the longitudinal bearings abutted against each other. I called the attention of a relative of mine, who was upon the engine with me, to it, and we observed it for many miles together; so that I am quite satisfied it was owing to no local or accidental circumstance.

The explanation of this—which I call singular and important phenomenon, as bearing upon the relative advantages of two modes of constructing the upper works of railways—is simple and easy. The space between the ends of the longitudinal timbers is too small, and the timbers themselves too large, and maintain too high a temperature, for the hoar frost to affect the ground between them; the consequence is, during the still and clear night, heat is constantly communicated to the rail above by radiation, but chiefly, I apprehend, by the conduction of the atmosphere; by which means it is kept at a temperature that prevents the deposition of dew, and consequently the formation of hoar frost. This effect is of course not confined to a point, but by the conducting power of the metal, diffused some little distance on each side the joining of the timbers.

Thus, if phenomena and circumstance were carefully attended to, many a lesson might be learned which would lead to improvement, and save hundreds of thousands in the construction of these costly undertakings. But to do it effectually, men must have courage to resist the allurements of comfortable carriages, and travel upon the engine—the only place where observations can efficiently be made—in all seasons and in all weathers. But our philosophising has carried us for the present too far from our friends on the Hull and Selby Railway.

Mr. Gray observed that frosty mornings were not the only times at which they found longitudinal bearings of much heavier draught than cross-sleepers. In wet weather it was the same, and the longitudinals much the heavier to travel over. As it had happened that rain to some extent had fallen, in the night preceding the morning on which we were out, we had an opportunity of witnessing the effect near one of the stations. A train was coming up, and we walked some little distance down to meet it. On its passing, I observed, even under the nail which fastened the rail to the timber, that water was expressed from between the timber and metal, as the engine passed, and re-absorbed the moment after. The same phenomenon, but in an inferior degree, occurred as the carriages passed. Hence, as Mr. Gray observed, "wherever the wheels are, in wet weather, it is a valley, and they are in the position of constantly ascending a hill," which of course much increases the draught.

In very dry weather, Mr. Gray does not think there is much difference between continuous bearings and cross-sleepers. From what I observed on the Midland Counties Railway, I am somewhat sceptical upon this. *I fear the draught is greater, under all circumstances, upon continuous bearings*, and, if I understand them rightly, I think Mr. Kearsley, the superintendent of the locomotives, and Mr. Woodhouse, the engineer of the Midland Counties Railway, are of the same opinion. It is, however, a matter well worth trying, and one which I should like much to put to the test of accurate experiment.

London and Birmingham Railway.

In my "Facts," &c., I omitted to mention that this Company have had nine detentions of trains, from defects of engines. In one case only was the detention nearly three hours; in another 2¾ hours; but the rest varied from about half an hour to about 1½ hour.

Railway Mag.

[To be continued.]

Mr. Vignoles' Lectures on Civil Engineering, at the London University College.

On Artificial Foundations.

Lecture I. Nov. 25th, 1841. After offering some comments on engineering generally, the lecturer alluded in particular to that important portion where the skill of the engineer was most required—viz: foundations. After some instructive remarks upon the subject, he said that for the foundation of bridges, a network of timber had been used, and was found to be very good so long as it was under water; but if it were liable to become dry, and exposed to the effects of the atmosphere, it was sure to fail. He recommended concrete as far superior to timber; he had seen concrete forced into a quicksand, and no weight could afterwards force it out. Brick earth and clay form excellent foundations; the whole of St. Paul's, except the north-east corner, was built upon such a foundation, of from four to five feet thick; at the north-east corner, the architect being afraid to trust it to the ground, it being rather softer than the other parts, had the clay removed, and a well, of from twenty to 30 feet square, sunk to a depth of about 40 feet, where the hard bed was found. He then raised a solid mass of masonry to within nine or ten feet of the surface; arches were turned, and the foundation finished at an enormous expense; whereas, a few cubic yards of concrete would have answered equally well, if not better. All must have noticed the hole that was filled up in laying the concrete foundation of the Royal Exchange; there a few cubic yards of concrete did the work more expeditiously, and as well as the ingenuity of the mason could have effected it. He alluded to some of the most remarkable instances of the prodigality of architects in laying foundations, as the Barriére de l' Etoile (a triumphal arch at Paris,) where the cost of the foundation far exceeded the amount of surface work; and the viaduct of the Valley Floré, in which a mass of solid masonry, thirty feet thick, was erected, extending all across the valley. In these cases concrete would have answered the purpose equally well, and at an enormous reduction in expense. He stated that the leading principles he wished to impress upon the minds of the students, were extension of base and equality of surface. He then, at some length, explained the different foundations that had been used for bridge building, and mentioned particularly Ranger's patent for curing defects where foundations have given way, viz:—by using hot water to concrete applied in boxes, the hot water causing the concrete to expand. This was applied to the foundation of the Custom House when it had given way, in consequence of a failure in the piling, which rendered necessary the application of an artificial for a natural foundation. He then remarked upon the various methods now in vogue for keeping the piles of bridges dry while under repair, alluding to caissons, and Mr. Tierney Clark's method of putting in the foundation of the landing place at Gravesend by portable coffer-dams. The Professor concluded his instructive lecture, stating his wish to popularise the knowledge of engineering, as a means of benefiting the public at large.

Lecture II. Wednesday, Dec. 1st, 1841.—In the first lecture, Mr. Vignoles gave the general principles of the various descriptions of foundations; in the present, he proceeded to illustrate those principles by diagrams. He stated, that if a good foundation were provided by nature, the subsequent operations were simple, the main point being to imitate nature as closely as possible. Where the soil was bad, considerable skill was required—for instance, in laying the foundation for the pier of a bridge, a wall, or a column, the first point was to give the base extensibility; in proportion as the natural soil was weak, so in equal proportion must the size of the base be increased; the pressure must also be equal—the soundness of the foundation not depending so much upon the amount of settlement as upon its equality. There were various ways of obtaining this, viz:—by the use of concrete alone, or in conjunction with timber, timber alone, or stone, or brick. Having so much insisted upon the necessity of an uniformity, it must be supposed that no portion of the artificial soil should escape; where that was likely, *sheet piling* must be resorted to. He then, by means of diagrams, explained the nature of the method, it being by driving piles close together, all round the foundation—the piles being (say) four inches thick, and as long as might be necessary. This method entirely prevented the escape of the soil in any manner but in a vertical direction, and ensured an uniform sinking, however bad the natural soil might have been. He then alluded to a very large chimney, twenty-two feet square, where the natural soil was a shifting quicksand; concrete was put in in layers, until the bed was eight feet thick; on this was placed a layer of flag-stones, five feet square. Eight days after the work was completed, the whole sunk eighteen inches, without the least deviation from the perpendicular. Other modes had been adopted, amongst which was the following: a number of timber balks were laid across, and concrete placed in the spaces between; then filled up with bricks: timbers were laid in a cross direction, and the flat stones placed upon them. In this instance the wood was laid where no change of atmosphere could affect it. The nature and use of a coffer dam was then explained, and the Professor, at some length, showed the danger of incautiously drawing the piles; the vacuity occasioned by their withdrawal being filled up by the surrounding matter, greatly injured the stability of the foundation. In making one of the London bridges, a great disfigurement had occurred in consequence of the incautious withdrawal of the piles, one side of the pier having sunk one foot. The modern plan to prevent such accidents, was to have a double coffer-dam, the piles of the inner one being cut off, when the outer piles might be withdrawn without danger. In laying foundations, he supposed there was a layer of soft ground, of moderate depth, with a hard substrata; piles must be driven through the soft soil, into the hard bed; a very slight depth would be sufficient, but still, in most cases, sheet piling would be necessary.

The Professor said that he was lately indebted to an officer of the Bengal Engineers, for an account of a very ingenious method, almost universally practised, in laying the foundations of temples and bridges in India. It would not answer here, labour being so dear; but there, where wood was very scarce, building materials in great plenty, and labor very cheap, it was the simplest and most effective that could be imagined. From the explanation, it appeared that the system was the same as piling, but, instead of using wood, small wells of brickwork were substituted. Take, for instance, the pier of a bridge; a small well of brickwork was constructed—say six feet deep, seven feet in diameter, with a hole through it, three and a half feet in diameter; this is placed on the sandy bed where the foundation is to be made; a workman gets into it, and undermines the well from the inside, the earth being drawn up in buckets; additional layers are added to the top of the well, until a sound bottom was reached; and the singularity was, that there was not one or two of these little wells, but hundreds, and, in certain cases, to a depth of fifty-five feet; arches were then thrown across, and the superstructure raised. When the foundation was in the bed of a river, the excavation went on by the workmen diving through the water to the bottom of the well, and working there until obliged to come to the surface for air; for instance, through ten feet of water in the river, and to the extent of forty feet of water in the well—one of the most extraordinary instances of perseverance upon record. English engineers had somewhat abridged the labor, by substituting an oblong square of fifteen feet by four feet, with two elliptical holes for the workmen; so that, instead of three wells of six feet, they get one of fifteen feet—the principle being precisely the same.

In France, a number of bridges had been built where the water was not rapid, upon a very simple foundation—a framework of timber being made, furnished with short piles at the corner, and laid in the bed of the river, and the superstructure raised upon it, by means of a wooden diving-bell. The *pier perdue* was another way, but could only be used in still water; a quantity of stones were thrown in until a foundation was obtained; where there was any current, this foundation was sure to give way, as in Plymouth Breakwater and Kingston Harbor. He then alluded to the case of one of the London docks, where the wall, being made with too great a curve, from the want of pile sheeting, the soil gave way—the engineer adding fresh matter until the toe of the wall actually appeared (to the astonishment of all) above the surface on the other side. He then gave examples of several original methods of preparing for the formation of foundations in Italy and Ireland, by means of baskets of stones, &c.

Concrete.

The Professor next explained the nature of concrete, and gave directions for its formation, viz:—one part of lime, twice that quantity of sand, and twice as much broken stone, or gravel, as there was sand.

The goodness of the concrete depended upon the quality of the lime. In making concrete, it must be borne in mind that the materials were far more bulky separate than when mixed—for instance, to make a cubic yard of concrete, which contained twenty-seven cubic feet, it would be necessary to have thirty-four cubic feet of materials, besides the water. The three ingredients should be mixed dry, and the water added; in slaking, the concrete will expand about one-thirtieth in bulk.

The great expense of coffer-dams, and of piers generally, had lately led to a very peculiar construction of bridges by piling only, as, for instance, in iron bridges no masonry being used. The Professor stated that he had built seven or eight bridges upon that system; the piles were driven in, and the iron work erected upon the wood. It had been tried to substitute cast iron for piles, instead of wood, but they had not succeeded, the iron being very liable to break. He also alluded to a beautiful arrangement for fixing branches to piles by means of a sliding collar, but which it is impossible to explain without diagrams. A French work, above two hundred years old was produced, with some very curious engravings of the modes then in use for securing foundations, and which proved that we are using the same means at present, and that many of our so-called new processes were in use at that time. He then concluded by stating, that at his next lecture he should bring forward some more general rules respecting foundations, and after that proceed to consider the best method of securing slopes of earth, now so generally in use.

Lecture III. Wednesday, Dec. 8th, 1841.—Mr. Vignoles explained that at his former lectures he had applied the term "concrete" too generally, and would now explain the difference between "*beton*" and "concrete." Beton was formed of the usual quantity of sand and gravel, broken stones, &c., but, instead of using the ordinary stone lime, hydraulic lime was applied. He then stated that beton is used exclusively under water, concrete only where water does not get in; beton never sets until it is under water, while concrete will not set except it is dry. The lime used for beton must be first slaked, while for concrete it slakes in the process of mixing. Beton sets best when let down gently in cases, and concrete when scattered from an eminence. Beton takes months to become hard, while concrete hardens in a few minutes. That both are in purport essentially the same—to form an artificial stone or rock—the one for works under water, and the other for those on land. He then alluded to the knowledge of the ancients of beton and concrete, and read extracts from the works of sundry authors, from Josephus to the present time, proving that assertion. The use of piles was also very ancient—the foundation of a brick pyramid, in Egypt, having been constructed on that principle. After impressing upon the minds of the students the great importance of a good foundation, and the efficacy of concrete for attaining that end, he concluded by stating that his next lecture would be again on the subject of foundations, and after that he would proceed to lecture upon slopes of earth, and explain the causes of the late accidents upon the different railways, pointing out where the errors of judgment had occurred.

Lecture IV. Wednesday, Dec. 15th, 1841.—Mr. Vignoles commenced by explaining the mode in which piles were driven it, and produced a model of a pile-driving machine (from the museum of the college,) by means of which, he showed the method in which steam power was applied to that machine, for expediting the work—stating, however, that, far from that application being a novelty, he had used it himself twelve or fourteen years ago.

Rock Foundations.

Having treated, in his former lectures, upon foundations in natural soils, or various kinds of artificial bases, he would now notice such as were of the composite order, being partly on rock, and partly requiring artificial means to render them sufficiently sound for the required purpose. It often happens that, in making a bridge, there may be rock on both sides of the river, and the first pier may rest upon rock, while the second and third may have an insecure foundation, in consequence of a "pot-hole" (as it is called) of sand unexpectedly being discovered in the very spot where these piers are to be erected. The only plan to get over this difficulty is to cut the edge of the hole in steps; sheet-pile it a short space from the wall of the hole, and fill up the intervening space between the piling and the hole with beton, or some other substance, and thus form a continuation of the rock itself. Difficulties also present themselves in solid rock foundations—for instance, in such an erection as that of the Devil's Bridge. The ravine over which the bridge is to be thrown, may have been formed by the running of water; the strata accordingly runs with the usual inclination on both sides. If foundations for the piers of the bridge were not sunk deep enough into the rock, the press of the water filtering through the fissures of the strata, have such force, that, notwithstanding the resistance of the arch, he had known instances of the pier being actually pushed outwards. The only method of avoiding this, was to sink the pier so low into the rocks, and, by means of steps, secure it so firmly, that the force of the water must *break* the pier—not force it outwards—before it could destroy the bridge. The Professor, before going into the question of rock foundations, begged to state, that, in these lectures he only laid down the general principles of foundations; he could not go into the details of the business; and the circumstances of stone foundations were so varied, that it was only by a life of labor and experience that the best method could be arrived at. He wished that each student should, in his private study, well consider, and, by reading, test the correctness of the principles which he laid down for their guidance. A whole year's lecture, repeated every day, would be no more than sufficient to draw the attention of the student to important points—the details could only be gained by practical experience. In preparing the foundation of lighthouses, the whole resources of the engineer must be called into action. A lighthouse must be built in such a manner that it must actually grow from the rock. There are instances where lighthouses have fallen in a body; he could mention one in Ireland, the foundation of which was a solid rock; he saw a party who witnessed its fall, and who informed him that it fell in a solid mass, tearing away a portion of the rock with it. The fault was, that the foundation was not sunk deep enough into the rock. He then alluded to the celebrated Pharos (of Pharos) of Alexander, which was justly reckoned one of the seven wonders of the world; it was built about 283 years B. C., and received its name from the island on which it was built; it was 550 feet high, and the base was 150 feet square, and could be seen at a distance of forty English miles. Josephus, and many other authors, had given descriptions of it, which pretty well agreed; and what was most extraordinary, that the very same method of making the foundation was practised then as now. The stones were dovetailed together, doweled, and run with lead—so as to firmly secure them in their places. The cost of the building amounted to no less a sum than £200,000 of our money, and it lasted above sixteen centuries. No diminution in its height occurred until after 1000 years from its erection, at which time about one-third of its height was wasted away by time; and it was only within about 400 years that the whole is supposed to have been destroyed, and that only by means of an earthquake. He then remarked, that it was very seldom that the name of an engineer was handed down for 2000 years, but all accounts agreed that Sosastros was the name of the engineer who erected this wonder of the world. The celebrated Corduan, or, as it is generally called, Cordovan, Lighthouse, at the mouth of the Garron, is built upon the same principles as the Pharos; this lighthouse is, however, circular, but the masonry is not calculated for durability—it being built of freestone. The expense of this lighthouse was enormous, as must be supposed when millions of francs were expended upon ornament, which was the more absurd when it was considered that it stood upon a barren rock, in the middle of the sea. He could not help quoting a line of Pope—

> "'Tis only usefulness that sanctifies expense."

This is a sentiment that he wished to impress upon the minds of all his students, for it was a great fault of modern engineers to expend great sums upon ornament, which could be far better employed upon actual necessaries. He then turned to the Eddystone Lighthouse, and related the histories and fates of the two lighthouses preceding the one now standing, which was erected by the genius of Smeaton, and strongly recommended his pupils to read the account published of that great work. The Eddystone rock is peculiarly interesting to the engineer; it is found first at about one mile deep in the ocean, and then rises gradually about one foot in ten, until it reaches near the level of the sea, when a sudden crop makes its appearance, and rises above the surface. From the peculiar formation of this rock, there is always a heavy run upon it, which renders it so very dangerous. The learned Professor, after explaining at some length the process of the erection of this celebrated lighthouse, concluded his lecture. Mining Jour.

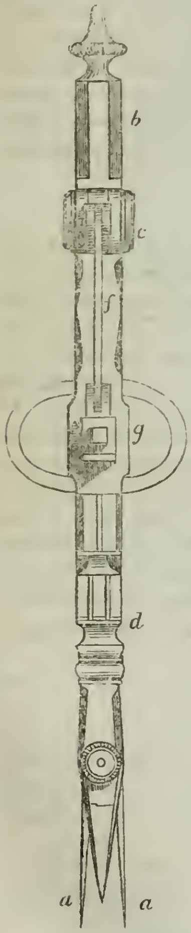
(To be continued.)

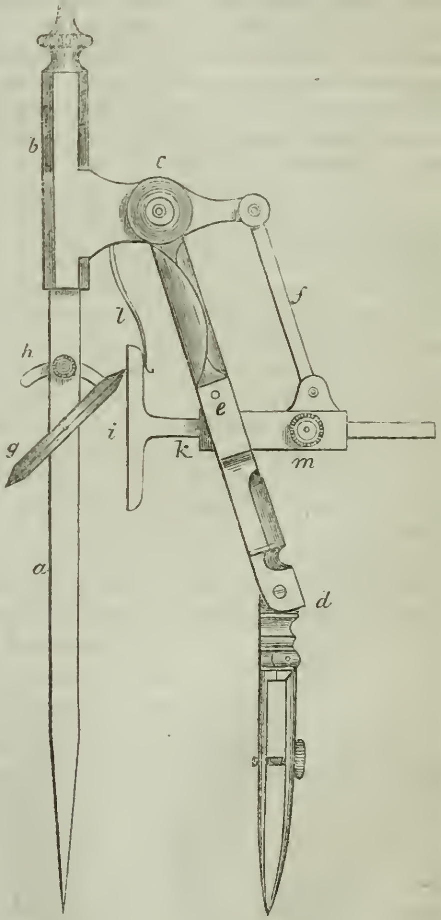
Davies' Elliptograph.

Mechanical draughtsmen have long required the assistance of some simple instrument which should, without any previous complicated adjustment, enable them at once to strike the ellipses, which would correctly represent the perspective of wheels and other circles.

Such an instrument has been designed by Mr. Henry Davies, already well known as the author of several other useful and highly important inventions, and we have much pleasure in adding to the list, that which is represented in the following engraving.

This ingenious little instrument consists of an upright stem, or axis, which terminates at its lower end in two points, *a, a,* to give it the required stability in a perfectly vertical position. On the upper part of this axis a compass head, *b*, revolves, having attached to it, by a joint at *c*, the pen, or compass limb, *c, d.* A square, horizontal shaft is jointed into the latter at *e*, and maintained in its position by the parallel rod, *f.* Upon the central shaft, or axis, *a*, there is pivoted a circular steel plate with beveled edges, *g*, which may be set at any required angle to the horizon by the quadrant and set screw, *h.* A T-shaped guide, *i*, has its longer stem, *k*, passed through the horizontal shaft, and held by the set screw, *m.* The face of the guide, *i*, is constantly kept in close contact with the edge of the circular disk, *g*, by means of a small spring, *l.*





A glance at this arrangement will almost suffice to show its operation. Suppose, in the first place, that the disk *i* is set perfectly horizontal, and the instrument applied to describe a figure upon paper; on turning round the compass limb and pen, *c*, *d*, a transcript of the disk, *g*, that is a circle, will be delineated, because the pen has been guided round in a circular path, by the spring *l*. Let the disk *g* be now set at any angle, say 45°, and the instrument applied to paper and turned round; the pen will again be guided round the disk *g*. but no longer in a circular path; an ellipse will be described, which will be the correct perspective of a wheel or circle, viewed at an angle of 45°; and so of circles viewed at any other angles, of a size within the powers of the instrument.

The set screw, *m*, allows the compass to be set to the size of the circle required; at the same time the guide, *i*, is always maintained in contact with the disk.

We hope and trust that this convenient and ingenious little instrument will be speedily brought before the public, in a form, and at a price, that will enable all parties to avail themselves of its important advantages. Mech. Mag.

Description of the Bann Reservoirs, County Down, Ireland.

By JOHN FREDERICK BATEMAN, *M. Inst. C. E.*

The situation fixed upon for the reservoir, rendered necessary the construction of four embankments between the hills, so as to raise the water to a height of 35 feet above the summer level of the lake.

These embankments were all constructed in a similar manner, only varying in the slopes and thickness of the stone facing, according to the extent and situation.

The whole substratum of the valley was water-tight, either from the existence of the solid rock, dense clay, or of hard, compact, mountain gravel; so that there was no difficulty in securing the foot of the puddle. A trench was sunk into the water-tight stratum, whence the vertical puddle wall was carried up with the bank to the required height. It was twelve feet in width at forty feet below the top, diminishing gradually to eight feet wide at the summit, and was worked in regular layers of eight inches in thickness.

The embankments were formed in concave layers, three feet thick —each layer being completed before another was commenced—steps being cut in the ground where necessary, to receive the layers.

In order further to secure the tightness of the bank, a lining of peat, fifteen inches in thickness, was brought up on the inside of the puddle, and a layer of the same material was laid upon the face of the slope; it was cut small, placed in thin courses like the puddle, and merely trodden down without more moisture than it naturally contained. The author advocates the use of peat in such positions, as from its light and fibrous nature, in case of a leak occurring, the draught would attract into it all the fibrous particles, which by degrees would stop the holes sufficiently for the silt to settle over, and effectually close, the aperture.

Above the peat, a course of gravel, three feet in thickness, was laid, and upon that the stone pitching, forming the inner side of the bank.

The inner slopes were, for twenty feet below the top of the bank, two and a half horizontal to one vertical; the outer were two horizontal to one vertical; where they were deeper than twenty feet, the remainder of the banks sloped three to one on the inside, and two and a half to one on the outside.

All the embankments are twelve feet wide at the top, and five feet above the water level.

The centre of the deepest part of the embankment was traversed by a stone culvert, in which were placed two rows of cast-iron discharge pipes, eighteen inches diameter, with suitable valves. A leak was discovered in the centre of the masonry of this culvert, occasioned by the engineer's instructions not being obeyed. The details of the methods employed for remedying this defect, are given at length, as also those of the experiments upon cements made by the author after the data given by Vicat. The materials which were most accessible for the work, were tested very carefully, and from the results, it was determined to employ mortar composed of rich Manx, or mountain lime, carefully slaked, and clay burned with peat in the open air. The proportions were two and a half of clay to one of lime. They were ground together, and being mixed with as much water as was necessary, the mortar was used immediately. The mortar for the backing had one measure of sand added; the grout had two measures of sand in it, and was used thin.

The concrete was composed of one part of lime, two and a half of calcined clay, and about three parts of sharp gravel.

This cement appeared to set hard, and to be perfectly tight; but when the reservoir was partially filled, several leaks were discovered, which rendered an examination necessary, and some energetic measures were taken to stop them, all which are described.

The result of the author's experience seems to be, that mortar made from rich lime and calcined clay, as recommended by Vicat, may set and harden under water, when there is little pressure, but that it is not able to resist the pressure of a considerable depth of water. *

The details of the construction of the masonry of the valve house, the fore bay, the waste weir, the bridge of three arches, constructed over the feeder from the river Muddock, and the various feeders for supplying the reservoir, are given at length, with the particulars of the expenditure of the sum of £14,891, which was the cost of the work, exclusive of land compensation, or salaries and professional charges.—*Proceed. of Instit. of Civ. Eng.*. Civ. Eng. & Arch. Jour.

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* Colonel (now Major General) Pasley, of the Royal British Engineers, in his admirable work on Cements, &c., having clearly proved that *a factitious water cement can* be made from *chalk-lime, and blue clay,* which will equal *the best natural cements* of England, we must ascribe this partial failure to some defect in the process of M. Vicat—which, it must be remembered, has received the censure both of General Treussart and Colonel Pasley, the best writers upon the subject of *water cements.* M.

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. Dumas.

[CONTINUED FROM PAGE 28.]

II. Since [the causes of] all the phenomena of life are exerted upon matters which have for their base carbon, hydrogen, azote, oxygen; since these matters pass over from the animal kingdom to the vegetable kingdom, by intermediary forms, carbonic acid, water, and the oxide of ammonium; lastly, since air is the source whence the vegetable kingdom is fed, and the reservoir in which the animal kingdom is annihilated—we are led to take a rapid survey of these different bodies with a special view to general physiology.

Composition of Water.

Water is incessantly formed and decomposed in animals and plants; to appreciate what results from this, let us first see how it is composed. Some experiments founded on the direct combustion of hydrogen, and in which I have produced more than two pounds of artificial water—experiments which are in truth very difficult and very delicate, but in which any errors would be unimportant with regard to the circumstances which we are engaged upon—make it very probable that water is formed, in weight, of 1 part hydrogen, and 8 parts oxygen, and that these whole and simple numbers express the true relation according to which these two elements combine to form water.

As substances always present themselves to the eyes of the chemist by molecules, as he always endeavors to connect in his thoughts, with the name of each substance, the weight of the molecule, the simplicity of this relation is not unimportant.

In fact, each molecule of water being formed of one molecule of hydrogen, and one molecule of oxygen, we arrive at these simple numbers, which cannot be forgotten.

A molecule of hydrogen weighs 1; a molecule of oxygen weighs 8; and a molecule of water weighs 9.

Composition of Carbonic Acid.

Carbonic acid keeps incessantly forming in animals, and is continually undergoing decomposition in plants; its composition, therefore, deserves a special notice in its turn.

Now, carbonic acid, like water, is represented by the most simple numbers. Experiments founded on the direct combustion of the diamond, and on its conversion into carbonic acid, have proved to me that this acid is formed of the combination of 6 parts by weight of carbon, and 16 parts by weight of oxygen.

We are, therefore, led to represent carbonic acid as being formed of one molecule of carbon weighing 6, and two molecules of oxygen weighing 16, which constitute one molecule of carbonic acid weighing 22.

Composition of Ammonia.

Lastly, ammonia, in its turn, seems formed in whole numbers of 3 parts of hydrogen and 14 of azote, which may be represented by 3 molecules of hydrogen weighing 3, and by one molecule of azote weighing 14.

Thus, as if the better to show all her power, Nature operates, in the business of organization, upon a very small number only of elements, combined in the most simple proportions.

The atomic system of the physiologist revolves on these four numbers—1, 6, 7, 8. 1 is the molecule of hydrogen; 6 that of carbon; 7, or twice 7, i. e. 14, that of azote; 8 that of oxygen.

These numbers should always be associated with these names, because for the chemist there can exist no abstract hydrogen, nor carbon, nor azote, nor oxygen. They are beings in their reality which he has always in view; it is of their molecules that he always speaks; and to him the word hydrogen depicts a molecule which weighs 1; the word carbon, a molecule which weighs 6; and the word oxygen, a molecule which weighs 8.

Composition of the Air.

Does atmospheric air, which performs so great a part in organic nature, also possess as simple a composition as water, carbonic acid, and ammonia? This is the question which M. Boussingault and I have recently been studying. Now we have found that, as the greater number of chemists have thought, and contrary to the opinion of Dr. Prout, to whom chemistry owes so many ingenious views, air is a mixture, a true mixture.

In weight, air contains 2,300 of oxygen for 7,700 of azote; in volume, 208 of the first for 792 of the second. The air, besides, contains from 4 to 6 10,000ths of carbonic acid in volume, whether it be taken at Paris or in the country. Ordinarily, it contains 4 10,000ths. Moreover, it contains a nearly equal quantity of the carburetted hydrogen gas, which is called marsh gas, and which stagnant waters disengage perpetually.

We do not speak of aqueous vapor, which is so variable; of oxide of ammonium and of nitric acid, which can only have a momentary existence in the air, because of their solubility in water.

The air, then, is constituted of a mixture of oxygen, azote, carbonic acid, and marsh gas.

The carbonic acid in it varies, and indeed greatly, since the differences in it extend almost from the simple to the double, from 4 to 6 10,000ths. May this not be a proof that plants take from the air this carbonic acid, and that animals take back a part from it? In a word, may not this be a proof of that equilibrium of the elements of the air attributed to the inverse actions which animals and plants produce upon it?

It has, indeed, been long since remarked, that animals borrow from the air its oxygen, and give to it carbonic acid; plants, in their turn, decompose this carbonic acid, it order to fix its carbon, and restore its oxygen to the air.

As animals breathe continually; as plants breathe under the solar influence only; as in winter the earth is stript, whilst in summer it is covered with verdure—it has been supposed that the air must transfer all these influences into its constitution.

Carbonic acid should augment by night, and diminish by day. Oxygen, in its turn, should follow an inverse progress.

Carbonic acid should also follow the course of the seasons, and oxygen obey the same law.

All this is true, without doubt, and quite perceptible as to a portion of air limited and confined under a jar; but, in the mass of the atmosphere, all these local variations blend and disappear. Accumulated centuries are requisite in order effectually to put in action this balance of the two kingdoms, with regard to the composition of air; we are then, very far from those daily or yearly variations, which we had been apt to look upon as being as easy to observe as to foresee. With regard to oxygen, calculation shows that, exaggerating all the data, not less than 800,000 years would be required for the animals living on the surface of the earth to consume it entirely.

Consequently, if we suppose that an analysis of the air had been made in 1800, and that during the entire century plants had ceased to perform their functions on the surface of the whole globe, the animals at the same time all continuing to live, the analysts in 1900 would find the oxygen of the air diminished by 1-8000th of its weight—a quantity which is beyond the reach of our most delicate methods of observation, and which, assuredly, would have no influence whatever on the life of animals or plants.

As to this, then, we cannot be deceived; the oxygen of the air is consumed by animals, who convert it into water and carbonic acid; it is restored by plants, which decompose these two bodies.

But nature has arranged everything so that the store of air should be such, with relation to the consumption of animals, that the want of the intervention of plants for the purification of the air, should not be felt until centuries have elapsed.

The air which surrounds us weighs as much as 581,000 cubic kilometres of copper; its oxygen weighs as much as 134,000 of these same cubes. Supposing the earth peopled with a thousand millions of men, and estimating the animal population at a quantity equivalent to three thousand millions of men, we should find that these quantities united consume in a century only a weight of oxygen equal to 15 or 16 cubic kilometres of copper, whilst the air contains 134,000 of it. It would require 10,000 years for all these men to produce a perceptible effect upon the eudiometer of Volta, even supposing vegetable life annihilated during all this time.

In regard to the permanence of the composition of air, we may say with all confidence, that the proportion of oxygen which it contains is secured for many centuries, even reckoning for nothing the influence of vegetables, and that nevertheless, these restore oxygen to it incessantly, in quantity at least equal to that it loses, and perhaps more—for vegetables live just as much at the expense of the carbonic acid furnished by volcanoes, as at the expense of the carbonic acid furnished by animals themselves. It is not then for the purpose of purifying the air that these breathe, that vegetables are especially necessary to animals; it is, above all, to furnish them incessantly with organic matter quite ready for assimilation—organic matter which they may turn to their advantage.

There is, therefore, a service necessary, without doubt—but so remote, that it can scarcely be recognised—which vegetables render us, in purifying the air which we consume. There is another service, so immediate, that if, during a single year, it were to fail us, the earth would be depopulated; it is that which these same vegetables render us by preparing our nutriment, and that of all the animal kingdom. In this, especially, is found, the chain that binds together the two kingdoms. Annihilate plants, and the animals all perish of a dreadful famine; organic nature itself entirely disappears with them in a few seasons.

We have, however, said that the carbonic acid of the air varies from 4 to 6 10,000ths. These variations are very frequent, and very easy to observe. Is not this a phenomenon reproaching the influence of animals who introduce this acid into the air, and that of vegetables which deprive it of it?

No; this phenomenon, you are aware, is a simple meteorological phenomenon. It is with carbonic acid as with aqueous vapor, which forms on the surface of the sea, to become condensed elsewhere, fall again in rain, and be reproduced under the form of vapor. This water, which is condensed and falls, dissolves, and carries with it carbonic acid; this water, which evaporates, yields up the same gas to the air.

A great meteorological interest would attach to the observation of the variations of the hygrometer, and those of the seasons, or of the state of the sky with the variations of the carbonic acid of the air; but hitherto all tends to show that these rapid variations constitute a simple meteorological event, and not, as had been thought, a physiological event, which, singly considered, would infallibly produce variations infinitely slower than those which are, in fact, observed as much in towns as in the country itself.

Thus the air is an immense reservoir, whence plants may for a long time derive all the carbonic acid necessary for their wants; where animals, during a much longer time still, will find all the oxygen that they can consume. It is also from the atmosphere that plants derive their azote, whether directly or indirectly: it is there that animals finally restore it.

The atmosphere is, therefore, a mixture which unceasingly receives and supplies oxygen, azote or carbonic acid, by means of a thousand exchanges, of which it is now easy to form a just idea, and the details of which a rapid analysis will now enable us to appreciate.

Gardener's Mag.

[TO BE CONTINUED.]

Hourly Meteorological Observations during the Equinoxial periods from December, 1840, *to March*, 1842; *made at the University of Nashville, Tennessee, in North Latitude* 36° 09′ 33″, *W. Long.* 86° 49′ 03″, *by* JAMES HAMILTON, *Prof. Math. and Nat. Phil.*

The position of the instruments is the same as reported heretofore. The only change of instruments is the substitution of Jones' Improved Englefield Barometer, in place of the old English Barometer. As I have not reduced the observations, it is proper to add that the cup is one inch in diameter, and one inch in depth. The tube is about one-tenth of an inch in diameter, and is marked 53.

December 21, 1840.

Hour.	Ex. Ther.	At. Ther.	Bar.	Weather.	Wind.		Remarks.
	deg.	deg.	in.		dir.	force.	
6 A. M.	21	33.5	29.780	Clear.	$\frac{\text{W.}}{\text{N.E.}}$	0	
7	21	33.5	29.782	do.	do.	0	Light clouds in horizon and some fog.
8	22.5	33.5	29.784	do.	do.	0	
9	29	35	29.782	$\frac{1}{2}$ Clear.	do.	0	Fog denser. Cinostratus.
10	34	35	29.788	do.	$\frac{\text{S. of W.}}{\text{N.E.}}$	1	Cinostratus.
11	37	36	29.754	$\frac{3}{4}$ Clear.	$\frac{\text{S.W.}}{\text{N.E.}}$	1	Cinus.
12	39	36.5	29.724	do.	do.	1	Cinostratus. Dew pt. 20.25°.
1 P. M.	41.5	37.5	29.696	do.	do.	1	do.
2	43.5	37	29.678	Clear.	do.	1	
3	43.5	37	29.662	do.	do.	2	No clouds, but hazy near horizon Dew pt. 24°.
4	41	37	29.646	do.	$\frac{\text{S.W.}}{\text{E.}}$	2	No clouds.
5	38	37	29.637	do.	S.E.	2	Stratum of clouds in West, and hazy in the East.
6	35.5	37	29.632	do.	do.	1	
7	34.5	37	29.624	do.	do.	1	West, stratum rising.
8	37	38	29.624	Cloudy.	do.	1	Sky covered with clouds.
9	38	38	29.638	do.	do.	1	Do. Dew pt. 28.
10	39	38	29.639	do.	do.	0	Do.
11	39	39	29.640	do.	do.	0	Do.
12	39	39	29.640	do.	do.	0	Do.

Minimum of Thermometer during night, . 39°

Morning of Dec. 22nd Wind N. E., but clear.

March 22, 1841.

Minimum during the night, ... 56.5°.

Hour.	Ex. Ther.	At. Ther.	Bar.	Weather.	Wind dir.	Wind force.	Remarks.
6 A. M.	61.5	62	29.182	$\frac{1}{2}$ Clear.	S.W.	2	Cirrus above and Cumulus below. Sun rises above thick cl'ds; shines dimly at 6h 50m.
7	61.5	62	29.182	do.	do.	2	
8	65	62.5	29.170	$\frac{1}{3}$ Clear.	do.	3	Clouds thicken at 9h. 50m. Wind 5.
9	69	63	29.169	do.	do.	3	
10	71	64	29.126	do.	do.	4	
11	73	64.5	29.100	$\frac{3}{4}$ Clear.	do.	4	Sun shines.
11½	Clouds more dense.						
12	76	65	29.050	do.	do.	3	
1 P. M.	77	66	28.990	Clear.	do.	3	
2	77	67	28.940	$\frac{1}{2}$ Clear.	do.	4	Clouding again.

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
3 P. M.	77	67	28.918	Clear.	S.W.	4	Dew point 56°.
4	75	67	28.900	Cloudy.	do.	5	
5	71	67	28.886	do.	do.	5	
6	69	67	28.880	*r.*	do.	4	Rain moderate.
7	66	67	28.871	do.	do.	1	Do.
8	62	66	28.866	R.	S.W.	2	Rain became heavy at 7h. 55m.
9	66	60	28.858	*r.*	do.	1	
10	60	66	28.850	*r.*	do.	2	
11	59	66	28.850	R.	S.W.by W.	7	Storm violent.
12	52	64	28.900	*c.*	W.	4	Begins to clear.

Minimum of Thermometer during night, . . 37°.

March 23—Barometer 29.210 N.W. Clear.

June 21, 1841.

Not observed more than other days.

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
9 A. M.	84	83	28.758	Clear.	S.W.	2	
Noon.	89	83	28.754	½ Clear.	do.	2	
3 P. M.	92	84	28.700	*c.*	do.	3	Dew point 66°.

Minimum of Thermometer, 69°. Thunder storms on 20th and 22nd.

September 21, 1841.

Minimum 65°.

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
6 A. M.	68	73	28.925	Cloudy.	S.W.	3	
7	69	73	28.922	do.	do.	3	A little rain fm. 7h. 50m to 8h. 05.
8	70.5	73.5	28.918	*r.*	do.	3	
9	75	74	28.904	*c.*	do.	4	
10	77	74.5	28.892	*c.*	do.	3	
11	75	74	28.892	*r.*	do.	3	
12	76.5	74.5	28.882	*r.*	do.	5	
1 P. M.	77	74.5	28.810	*c.*	do.	5	
2	76	74.5	28.808	*r.*	do.	2	Rain heavy from 2h. to 2½h.
3	76	75	28.810	*c.*	do.	2	Dew point 64°.
4	77	75	28.810	*c.*	do.	2	
5	74	75	28.818	*c.*	do.	1	
6	71	74.5	28.818	*c.*	do.	1	Signs of clearing.
7	69	74.5	28.812	*c.*	S.W.by W.	0	Lightens in S.
8	68	74	28.812	*c.*	do.	0	Do. Clouds in W.
9	68	74	28.816	*c.*	do.	0	Lightens in W. Clouds increase.
10	65	74	28.820	*r.*	W.	3	Th. Storm at 9h. 40m.
11	63	73	28.826	*c.*	W.	1	Clearing.
12	62	73	20.826	*c.*	W.	1	Do.

Minimum during night . . 58°.

September 22—Cloudy, but wind from West. Barometer at 9 A. M. 28.836.
Amount of rain 24-100 inch.

December 21, 1841.

Minimum of Thermometer, . . 41°.

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
6 A. M.	41	47	29.442	*c.*	$\frac{\text{S.W.}}{\text{N.E.}}$	2	Amount of rain on 20th, .70 inch.
7	41	47	29.450	do.	do.	1	
8	41	47.5	29.500	do.	do.	2	Clouds break in N.
9	41.5	47.5	29.534	do.	do.	3	
10	43	47.5	29,544	do.	do.	3	Clouds light in N.; heavy in S.
11	45	47.5	29.544	do.	do.	3	Do.
12	46	47.5	29.506	do.	do.	3	Do. Dew point 31°.
1 P. M.	47	47.5	29.500	do.	do.	3	
2	47.5	47.5	29.496	do.	$\frac{\text{S.W.}}{\text{E.}}$	3	Almost clear in N.
3	46	47.5	29.490	do.	E.	3	

Hour.	Ex. Ther. deg.	At. Ther. deg.	Bar. in.	Weather.	Wind. dir.	Wind. force.	Remarks.
4 P. M.	45	47.5	29.502	*c.*	E.	2	
5	45	47.5	29.500	do.	do.	2	
6	45	47.5	29.498	do.	do.	2	
7th, 8th, and 9th hours, no change.							
10	45	47	29.498	do.	do.	0	
11	45	46	29.486	do.	do.	0	
12	45	46	29.484	do.	do.	0	

December 22—Min. 44°. Bar. 29.418 at 9 A. M.

Amount of rain on 21st = .08; on 22nd = .72.

March 21, 1842.

Minimum of Thermometer, . . 65°.

6 A. M.	67	71	29.050	*c.*	W.	3	
7	68.5	71	29.072	*c.*	do.	3	
8	69.5	71	29.080	*c.*	do.	3	
9	68.5	71	29.100	*c.*	do.	3	
10	72	71.5	29.084	*c.*	do.	3	
11	73	71.5	29.086	*c.*	do.	3	
12	76	72	29.052	Clear.	do.	3	Clouds only in S. Dew pt. 55°.
1 P. M.	77	72	29.020	do.	do.	2	Wind rises at 1½ P. M.
2	78	72.5	28.996	do.	do.	5	
3	79	72.5	28.984	do.	do.	5	
4	79	72.5	28.980	do.	do.	5	
5	78	73	28.976	do.	do.	5	
6	74	73	28.986	do.	do.	4	
7	73	73	28.990	do.	do.	2	Cumuli in N.
8	71	73	28.992	do.	do.	1	
9	70	73	29.020	do.	do.	1	
10	69	72.5	29.038	½ Clear.	do.	2	A few thin clouds.
11	67.5	72.5	29.054	Clear.	do.	2	
12	66	72	29.060	do.	N.	0	

March 22—Min. of Ther. 48°. Bar. 29.196 at 9 A. M. Wind N. E., but clear.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A Comparison of the Mean Temperature of the Year with the Mean Temperature of October and April. By C. B. HAYDEN.

Pouillet, in the meteorological portion of his Eléméns de Physique, &c., announces as a general law the close approximation of the mean temperature of October to that of the year, and asserts that the former may be regarded as a substitute for the latter, and quotes, in illustration, a table from one of Humboldt's Meteorological Memoirs, which sufficiently confirms the law for the contained localities. To ascertain how far this law was applicable to the United States, the accompanying table was compiled from data furnished by the North American Almanac, Army Register, and such other sources as were most readily accessible. This table includes localities from a wide area of country, presenting a great variety of climate, not only as dependent upon latitude, but upon literal and inland situation. The * in the table indicate that for the localities to which they are annexed, the mean temperature of April is nearer that of the year than the mean temperature of October; and as this number amounts to forty-one, out of seventy, localities, or about fifty-nine per cent., it shows an important variation of the above-mentioned law, in reference to the United States. The closer approximation of the mean temperature of April to that of the year, seems to be general, not only for the more uniform climate of the coast and great lakes, but the more excessive climate of the interior, as well as for the northern and southern portions of the Union—though the exceptions in favor of October are most numerous in the middle and southern States. As a general rule, the mean of October is *higher* than that of April, and both are *lower* than the mean of the year in the United States.

Localities.	Mean of Year.	Mean of October.	Mean of April.	Series of Obs. years.	Observers.
Baltimore *	52.94	54.87	52.12	8	L. Brantz.
Salem *	48.86	51.34	46.62	43	D. Holyoke.
Medfield *	46.48	50.11	43.18	12	D. C. Sanders.
Eastport *	41.75	46.08	39.50	2	
Burlington	43.60	47.70	39.40	1	
Albany *	44.73	42.32	42.71	1	
Auburn, N. Y. *	44.75	40.71	41.77	1	
Canandaigua, N. Y.	43.78	42.42	51.44	1	
Cherry Valley,* "	41.25	37.91	40,72	1	
Clinton "	46.92	48.89	42.83	1	
Cortland * "	42.04	38.43	40.45	1	
Dutchess * "	47.32	45.24	46.60	1	
Erasmus "	47.73	47.28	46.21	1	
Fairfield * "	42.48	37.53	41.89	1	
Fredonia * "	44.54	41.54	44.76	1	
Granville "	45.88	48.09	42.04	1	
Hamilton * "	40.45	35.98	39.98	1	
Hartwick * "	44.92	39.66	45.38	1	
Ithaca * "	44.28	40.21	42.75	1	
Johnstown "	42.31	40.76	38.62	1	
Kinderhook * "	43.81	40.39	42.37	1	
Kingston * "	45.94	43.58	44.17	1	
Lansinburgh "	47.82	46.73	41.40	1	
Lewiston "	43.54	40.27	40.20	1	
Monroe * "	44.69	40.84	43.18	1	
Montgomery * "	44.25	39.30	41.74	1	
Newburgh * "	45.73	44 35	45.26	1	
Oneida * "	44.31	40.16	40.41	1	
Onondaga * "	45.16	41.60	42.81	1	
Oxford * "	42.80	39.85	41.44	1	
Pompey * "	40.18	36.11	39.21	1	
Redhook * "	46.11	44.65	46.28	1	
Rochester * "	44.01	41.36	42.92	1	
St. Lawrence * "	40.78	36.88	40.01	1	
Schenectady "	44.66	43.27	42.66	1	
Union "	43.11	40.51	38.70	1	
Union Hall "	46.52	45.47	45.07	1	
Utica "	40.89	39.34	37.81	1	

Localities.	Mean of Year.	Mean of October.	Mean of April.	Series of Obs. years.	Observers.
New Orleans	66.00	65.11	69.25	1	Dr. Barton.
St. Louis	54.35	52.10	58.55	8	
Fort Howard *	45.282	50.02	43.25	5	Army Register.
Fort Wolcott	50.28	54.20	45.71	5	“
Fort Columbus	53.13	55.85	49.15	5	“
Fort Snelling *	45.77	49.50	42.49	3	“
Fort Preble *	46.92	49.20	45.01	3	“
Fort Niagara *	51.69	58.94	47.52	2	“
Fort Brady	41.84	46.43	37.20	3	“
Fort Armstrong *	51.57	55.36	51.29	3	“
Fort Monroe *	61.57	57.58	64.33	3	“
Fort Vancouver	51.75	54.00	46.00	3	“
Fort Gibson *	62.90	65.95	61.28	3	“
Fort Hancock *	41.21	45.66	43.84	2	“
Council Bluffs *	51.80	57.41	47.95	3	“
West Point	52.74	52.66	50.54	3	“
Washington	55.68	56.41	53.71	3	“
Jefferson Barracks *	57.77	59.18	56.12	3	“
Augusta Arsenal	65.24	46.76	64.29	3	“
Petite Coquille	71.40	73.10	69.28	3	“
St. Augustine	72.24	73.61	68.68	3	“
Dover, N. H.	44.50	46.60	48.70	7	A. A. Tuffts.
Summerville, Ga.	66.52	68.00	63.96	1	Dr. Holbrook.
Natchez	67.50	71.60	74.90	1	Dr. H. Tooley.
Bloomington, Iowa,	54.20	60.70	62.70	1	T. S. Parvin.
Marietta *	51.80	50.94	52.49	10	S. P. Hildreth.
Key West	76.50	77.45	74.50	7	S. Whitehead.
Nashville *	59.00	62.30	61.94	2	Prof. Hamilton.
Providence *	46.90	51.32	44.58	2	Prof. Caswell.
Dartmouth *	40.10	43.08	37.63	3	
Concord	43.37	42.33	45.60	10	M. J. Farmer.
Savannah *	66.11	68.60	67.31	2	

Abington, Va., May 24th, 1842.

On Fossil Bones found on the Surface of a Raised Beach, at the Hoe, near Plymouth. By Dr. Moore.

In our reports of the Meeting of the British Association at Plymouth, (*Athen.* No. 721,) an abstract will be found of a paper, by Dr. Moore, on those fossil bones, and a notice of the objections which were made to the author's inferences. In the memoir read to the Geological Society on the 5th of January, the substance of the former communication is given, but its principal object is to prove,—1st, That the bones could not have been derived from the emptying of a cave, bearing all the evidence of having been deposited where they were found at a very remote period, and probably long before they could have been affected by human agency; 2ndly, That the beach with associated bones could not be a diluvial, or drift, accumulation, because it resembles in character a modern beach, and contains marine shells, and because the bones were found not in, but upon, the deposit; 3rdly, That the beach did not result from glacial action, as there are no indications of it in the neighbouring districts; lastly, he maintains his former views respecting the beach having been raised above the level of the sea, and at a period about, or probably more recent than, the time when the animals, whose remains are found upon it, disappeared. Appended to the paper was a note on a mass of limestone perforated by irregular cavities, considered, by Dr. Buckland, to be due to the action of snails, but which Dr. Moore conceives were formed by pholades.—*Transactions Geological Society.* Athenæum.

An account of the Contortions and Faults produced in the Strata underneath and adjacent to the Great Embankment across the Valley of the Brent, on the Line of the Great Western Railway. By MR. COLTHURST.

The vegetable soil, on which the embankment was thrown up, rests on a stratum four feet thick, of brown or alluvial clay, under which is a bed of gravel, varying in thickness from ten to three feet, and the whole reposes on London clay of the usual characters. The surface of the valley at this part gradually slopes towards the Brent, the difference of level between the southern or more distant side of the earthwork and the river, being about twenty feet. The height of the embankment is fifty-four feet. On the night of the 21st of May, a settlement was first noticed, and in the morning the foundation was discovered to have given way, and a large mass of ground fifty feet long and fifteen feet wide, to have protruded on the south side, towards the Brent. During the four succeeding months this mass continued to increase, and the disturbance to extend, so that, at the end of that period, the surface, to a considerable distance from the base of the embankment, had assumed an undulated outline, and the subjacent strata, where they were cut into, exhibited corresponding curvatures, cracks, and overlappings in the beds, due to horizontal movements. In the earthwork itself, up to this time, the only evidence of failure, in addition to a sinking in the surface of fifteen feet, was a large crack near the top, and on the side opposite to that in which the foundation had yielded, but slanting towards the same point. Passing over the effects gradually produced during a period of nearly twelve months, at the end of which the total subsidence had exceeded thirty feet, and the swollen ground at the base of the embankment had attained an average height of ten feet, with a range parallel to the earthwork of nearly four hundred feet, and an occasional horizontal displacement of fifteen feet, the author proceeds to describe the nature of the curvatures and other irregularities produced in the strata extending two hundred and twenty feet, or from the foot of the earthwork to the Brent, the bank of which was forced five feet inwards; but it is impossible to render the account intelligible without the aid of diagrams. The remedy applied by Mr. Brunel was a supplementary embankment, or terrace, thrown down on the protruded mass; and it has proved effectual. In the second part of the paper, the author dwells upon the magnitude of the disturbing effects thus produced by human agency, and asserts his belief that many of the distortions visible in the solid strata of the earth may have been produced by the effects of superincumbent masses thrown down upon them by the ordinary operations of nature; but while he advocates the explanation of certain geological phenomena by means of pressure from without, he does not deny that many, and more especially the most considerable irregularities which occur in the structure of the earth, may be assigned to other causes. Ibid.

Franklin Institute.

COMMITTEE ON SCIENCE AND THE ARTS.

Spaulding & Isherwood's Cast Iron Rails for Railroads. *

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the model and drawings of Cast Iron Rails for Railroads, invented by Messrs. Spaulding & Isherwood, of Owego, New York, REPORT:

That they have attentively examined the model and drawings of this rail, which have been submitted to the Institute, and have discussed the merits of the invention.

They find that this *cast iron rail* consists of two curved ribs in a vertical plane, about eight inches asunder, and upon the upper one reposes a tangent bar, on which the wheels run; these three essential parts are connected and braced by a system of radial posts, combined with diagonal braces; the whole being cast in a conjoined mass, in lengths of ten feet. It is, in fact, a cast iron arch (with a level extrados) nine inches deep at crown, and twenty-one at spring, the skewbacks being joined by a wrought iron tie-bar upon the chord, to secure sufficient abutment.

The quantity of materials required for a mile of single track railway, upon this plan, with a pile foundation, as calculated by the inventors themselves, would be:

140 tons of *cast iron*,
20 tons of *wrought iron*,
1056 *oak piles*, of 11 to 17 inches diameter.

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* An isometrical engraving of the *cast iron rail* under consideration, will be found in the American Railroad Journal, for July 15th, 1841, accompanied by a very lucid description. written by the inventors themselves, and this engraving and description have been further circulated through the country in a descriptive memoir, issued in pamphlet form, by Messrs. Spaulding & Isherwood, for the information of the public. Those who feel an interest in this matter can easily refer either to the valuable periodical above mentioned, or to the descriptive pamphlet of the inventors—copies of which they would, doubtless, furnish, for the information of any who might contemplate the use of their rail. Com. Pub.

The amount of wrought iron was originally designed to be fifteen tons per mile, but additional cross ties have since been judiciously proposed by the projectors, to strengthen the rail against lateral action.

In the Railroad Journal, for July 15th, 1841, we find a detailed account of this rail (as originally projected,) illustrated by a very lucid isometrical drawing, which seems to render unnecessary a more particular description by us; and to this we refer those who wish to examine more minutely into its structure.

A railway constructed upon this plan would consist, in chief, of a series of cast iron arches, of ten feet span and one foot rise—each line of rails forming, indeed, *a continuous arched bridge*, in which the thrusts of the separate arches would be neutralized by the chord bars, and which would be kept in place laterally, by direct and diagonal transverse ties, of wrought iron.

This mode of constructing bridges of cast iron, *is not novel;* it is, in fact, the same in principle as that executed in the bridge which carries the London and Birmingham Railway over the Regent's Canal, near Chalk Farm; and the same idea—that of springing arches of cast iron from wrought iron tie-bars, secured to their skewbacks—has been put in practice on other English railways. (See Brees' Railway Practice, and Simms' Public Works of Great Britain.)

But the actual application of the trusses of such bridges, in a continuous line, to form the rails of railways, *is new*, (though the mere suggestion of a similar plan has been before made,*) and upon this adaptation of a known method of construction to a new use, must rest *the claim to novelty* of the rail under consideration.

Messrs. Spaulding & Isherwood propose to establish their cast iron superstructure upon foundations of oak piles, each from eleven to seventeen inches in diameter, and to be firmly driven by a ram of 1200 lbs., with twenty-eight feet fall.

In answer to a letter addressed by us to the inventors, they state: that twenty feet lineal of single track, upon this plan, has been for eight months in use, upon the Ithaca and Owego Railroad, daily traveled at a pace exceeding ten miles an hour, by an eleven ton, six-wheeled locomotive, with passengers and freight in trains of ninety tons average weight—amounting in all to about 24,000 tons gross, transported over these rails; that no rails have yet broken; that the piles do not settle; that the freight referred to was carried in cars without springs: and, that this part of the track remained wholly free from snow, when other portions of the same road were deeply covered.

The inventors also inform us, that, with an hydraulic press, they tested the strength of two patterns of their rail—each of ten feet span.

The first, weighing sixty pounds per yard, broke in its *lower arch*, under a weight of twelve tons; but the upper arch and chord bar were not broken, until the latter (one inch in diameter) was torn asunder by augmenting the strain.

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* Some years ago, Henry R. Campbell, Civil Engineer, of this city, proposed to use each separate truss of a cast iron bridge as the sustaining part of a line of wrought iron rails—designing, in this manner, to pass the Schuylkill river, near the city, with spans of 125 feet; which, like those of the plan before us, were to be retained in position laterally, by wrought iron tie-bars, and which was equally to be without a floor.

The second, weighing seventy-eight pounds per yard, (the same as those in trial on the Ithaca and Owego Railroad,) and having a one and a half inch chord bar, sustained twenty, but fractured in its *lower arch*, with twenty-two tons weight—though even then it did not fall down.

These experiments show that this rail, when of the weight of seventy-eight pounds to the yard lineal, possesses abundant vertical strength for railway purposes, and its practical use upon the Ithaca and Owego Railroad—as far as it has gone—is quite satisfactory, as we are informed, though we have also received intelligence, from a correct source, that in a similar experiment tried upon the New York and Erie Railroad, two rails were fractured at the ends, after a very brief use indeed; and it is evident that the amount of the passing trade, in the former case, has not yet been sufficient to fully test its merits.

As this structure is designed to stand in relief, about two feet clear of the ground, no one in a northern climate will lose sight of the advantage it will therefore possess in being easily kept clear of snow; and in the passage of small streams, or such as are not exposed to heavy drift, this railway will form a bridge for itself, without requiring the aid of a particular building for its use.

In curves, these rails will form a succession of chords of ten feet. and as piles, or any similar supports, of less base than altitude, present of themselves but little lateral stability, it would seem probable that the constant impinging of the wheels in the multangular line formed by the series of chords—especially in curves of small radii—would render the maintenance of the way difficult in such places, if, indeed, fracture did not result from this action, (notwithstanding the transverse ties,) owing to the apparent weakness of the rails in the centre; but actual experiment alone can determine what value there is in this objection.

The great depth of the rail at the skewback, will, in case of the subsidence of any pile—the rail revolving upon the opposite springing line as a fulcrum—cause the adjacent joints to open at top, to an extent at least double of what would result from the same settlement in an ordinary rail on detached bearings, three feet asunder; besides, bringing a strain on the subsiding joint well calculated to produce fracture. All which is certainly objectionable.

The risk of accident upon a decaying pile road, laid with these rails—in consequence of their elevation from the ground—ought not to be overlooked; for experience shows that in the general repairs of railways, timbers are not always renewed before they fail, though life should pay the forfeit of neglect: and hence it would seem, that a due regard to public safety would require that the timbers of such roads should be (if possible) protected from decay; but this would considerably enhance the cost per mile.

If within reasonable limits of cost, the consecutive arches of such a structure could be established upon solid, unyielding, and indestructible piers, it would then become an economical cast iron bridge, with a series of small spans, *and its complete success on tangent lines could not be doubtful;* but the Committee, as at present advised, are strongly inclined to the belief that, under the usual circumstances of railways, it would be difficult, if not impracticable, to procure, at a sufficiently moderate expense, that stability of foundation which, in their view, seems indispensable to the success of such a plan.

Finally, we will conclude by observing, that as the most serious objections to this rail involve considerations of comparative working cost, and as these can only be determined by experiments on *a sufficient practical scale,* we hope that the means will be afforded by some of our railway companies, to enable such trials to be made under the direction of the ingenious projectors—both on short curves and high embankments, and in the passage of streams—for the rail in question evidently has enough vertical strength, and possesses other important advantages, sufficient to recommend it for impartial experiment; but though there is strong reason to hope for successful results, *the Committee are not yet prepared to advise its general employment upon railways.*

By order of the Committee,
April 14*th,* 1842. William Hamilton, Actuary.

Note by one of the Collaborators.

The successful application of cast iron to form the rails of railways —which is even now a desideratum—will, when the admission of foreign railway iron, *duty free, shall cease,* evidently become of such importance in this country, that the experiments upon Spaulding & Isherwood's ingenious cast iron rail, which are now in progress in the state of New York, have deservedly excited considerable interest. Its vertical strength is unquestionable—indeed, far superior to that of any rolled iron rail, of the same weight, now in use—and it is to be hoped that those gentlemen will persevere in their trials and modifications of the pattern, until the properties of the invention shall be fairly developed by practice.

To enable the cost of this cast iron superstructure to be compared with that of the seventeen railway tracks of rolled iron, of which we compiled an estimate in the last volume of this Journal, page 158, the following is submitted:

Estimate of the probable Cost of a Mile of Single Track Railway, upon the Cast Iron Arch plan of Messrs. Spaulding & Isherwood.

140 tons of *cast iron,* from the Blast Furnace, delivered upon the line of road, at, say $45, per ton, .	=$6300 00
20 tons of *wrought iron,* ties, &c., complete, at, say $100 per ton, ...	= 2000 00
1056 *oak piles,* including delivering, driving, &c., and laying the superstructure, as estimated by Messrs. S. & I., conformably to the known expense of piled roads,	= 1500 00
Total, ...	=$9800 00

If this estimate is not incorrect, it would seem that the *cast iron arched railway* is likely to be more economical, in first cost, than the usual superstructure of rolled iron edge rails—to the extent, at least, of the saving in embankment, drainage, &c., which may be effected by the former. M.

Calderhead's Carpet Loom.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an improvement in the Loom for weaving Carpets, &c., invented by Mr. Alexander Calderhead, of Philadelphia, Pennsylvania, REPORT:

That Mr. Calderhead's loom is a material modification and simplification of the Jacquard and other draw looms, for weaving carpets and other figured cloths. It dispenses with all machinery above the working parts of the common loom, and is thereby so reduced in height, that it may readily be placed in a common apartment without requiring the removal of the ceiling. The *harness* consists simply of *heddles*, or heilds, made of wires, about twenty-four inches long, and each pierced with an eye, for a thread of the warp to pass through, in place of the mails, twine, and leads, of the Jacquard harness. The heddles work vertically, in holes through two boards, or plates, resembling cumber-boards, the upper of which may be called the *rest-board*, and the lower the *guide-board.* The heddles have each a head at the top, which prevents their falling through the rest-board, and enables it to raise them when raised itself. The *cylinder*, or trunk, is a four or six-sided long and slender box, with pivots at the ends, and it extends horizontally across the whole width of the loom directly beneath the heddles; it is pierced on each side with holes corresponding to those of the cumber-boards, and the *pattern-cards*, or apron, rest upon it, and revolve with it—so that when the cylinder is raised and the rest-board lowered, the blanks of the card raise the proper heddles, while the remaining ones drop through the holes of the card, and of the cylinder beneath it, to form the sheed, or opening, for the shuttle to pass through. Thus the width of the sheed is equal to the distance which the heddles penetrate into the cylinder, and the upper and under threads of the warp are stretched alike. The cylinder turns on bushes, in a frame which slides vertically, and which, being raised by levers connected with the treadle, raises the cylinder. But the cumber-boards slide vertically and separately in the same frame, and the cylinder as it rises lifts the guide-board, with a part of the heddles; but the sliding frame acts upon two levers, supported from the cross-beam above, and thereby lowers the rest-board, and allows the proper heddles to descend into the cylinder. The guide-board is suspended from the rest-board, so that it cannot fall too far below it when the cylinder descends; and by means of a wheel at the end of the cylinder—having as many inclined teeth as the cylinder has sides, and these teeth acted upon by a kind of ratchet hooking against them—the cylinder as it descends is turned, so as to bring the next side uppermost, and bring the next figure of the pattern cards into operation when the cylinder is raised again. By means of a like wheel on the other end of the cylinder, its motion may be reversed, and the pattern moved in the opposite direction.

The Committee believe the whole contrivance above described to be original, and exceedingly simple, ingenious, and effective, costing less than the machinery for which it is proposed as a substitute, in the outset, and producing a considerable saving in subsequent repairs of the twine required in other harnesses. The inconvenience arising from the stretching of the twine, is in this loom entirely avoided. It is alike adapted for cumber work, where the figure varies throughout the whole width, and point work, where the figure is symmetrical. It may be used for fabrics of two or more plies, or thicknesses, and requires for them merely a single pattern. The only objection to its use which has occurred to the Committee, is, that the fly or downy matter from the warp may in time clog the cylinder; but if this should be the case, that part may be easily removed and cleaned out, and there is little reason to apprehend any difficulty from this source. The committee would warmly recommend this invention to all manufacturers of carpets and figured fabrics, while they accord high praise to the meritorious inventor.

By order of the Committee,
June 9th, 1842. William Hamilton, Actuary.

Practical & Theoretical Mechanics & Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

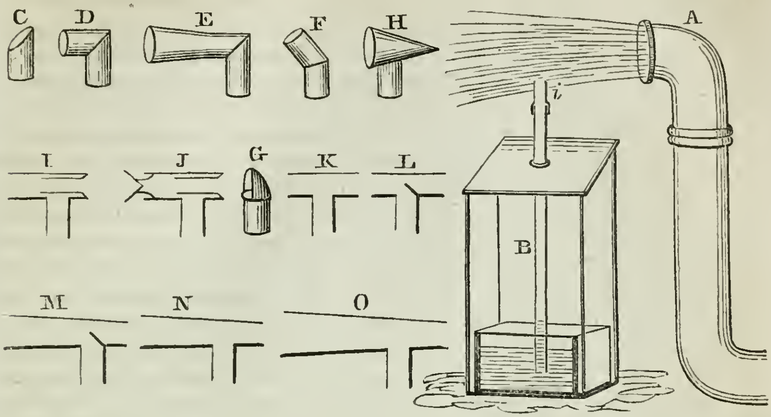
On the Comparative Value of various forms of Chimney Caps and Ventilators. *By* Thos. Ewbank *and* J. L. Mott.

To the Committee on Publication:

Gentlemen—The following experiments by Jordan L. Mott, Esq., and myself, are submitted for insertion in the Journal of the Franklin Institute. Yours, respectfully,

New York, July 1st, 1842. Thomas Ewbank.

The object of these experiments was to determine the comparative value of various forms of chimney caps and ventilators. To do this with a tolerable degree of precision, a uniform current of wind of sufficient volume and force, was necessary; and it was equally requisite that the model of every cap tried should be placed in the same favorable position in the experimental current. We endeavored to realize these conditions in the following manner: In Mr. Mott's iron foundry three cylindrical bellows, each twenty inches diameter, and thirty inches stroke, are employed; the pistons are moved alternately by a triple, or three throw, crank. From these bellows the ærial current, or blast, was derived; the wind from all of them was conveyed about twenty feet through a five inch pipe, where it issued in a horizontal direction through the tube A, whose orifice was three inches in diameter. To render the blast as equable as possible, the steam engine that worked the bellows was kept going at a uniform speed during the time occupied in experimenting. The blast, however, was not, after all, very uniform, and the consequence was a slight oscillation of the water in the gauge that measured the results.



Eight inches from the open end of the blowing pipe, A, a glass tube, B, an inch and a quarter bore, and twenty-eight inches long, was secured in a frame. Its lower end descended into a vessel of water, as represented, and to its upper end was fixed a ferrule, *i*, of tin plate. To this ferrule the vertical tubes of the caps were accurately fitted, so as to be slipped on and off without disturbing B. The models were made of tin plate, and the vertical tubes attached to them were all of the same dimensions, viz: $1\frac{1}{2}$ inch long and $1\frac{3}{16}$ inch bore. The glass tube which may be supposed to represent a chimney, was designed, as the reader will have already perceived, to measure the degrees of rarefaction produced within it by the caps—the ascent of the fluid indicating the effect of the blast of wind on each. Except when otherwise noticed, the axes of the caps, or horizontal tubes, were made to coincide with that of the current. With the view of verifying the general results, and to detect any variation in the force of the blast, from slight changes in the speed of the steam engine, the experiments with each cap were repeated, at short intervals of time, but no very obvious changes in the results here recorded were observed.

Experiment I.—The first experiment was with the tube B, as figured in the cut. It was raised till the orifice of the ferrule was in the centre of the blast; but in no part of the current was any rarefaction produced. The water was neither elevated nor depressed within the tube. Had the upper end been inclined towards A, wind would have entered and displaced the water from the bottom of the tube; and, on the other hand, had it been inclined in the opposite direction, a slight ascent of the fluid would have followed; but it was not deemed of sufficient importance to try either.

Experiment II.—The tube C was now slipped on the ferrule in the position in which it is figured. It will be perceived that at the side away from the blast, a portion is removed, as if to form with a similar tube a mitred joint, or a right angled elbow. With this device the water rose in B from 1¾ to 2½ inches above its level in the vessel. By turning the open part of C till it was nearly parallel with the blast, little or no change in the extent of rarefaction took place.

Experiment III.—D was next tried. It consisted of two tubes like C, united at right angles. When the horizontal branch was in the direction of the current, the water oscillated in the tube from 1½ to 2¼ inches. Upon turning the cap till its axis formed an angle of 45 degrees with that of the current, the liquid column rose to 3¼ inches; and when the angle was 90 degrees, the water fell to 2½ inches. An elevation, however, greater than was obtained when the cap ranged with the blast. The cap was next turned to its first position, and a conical tube, six inches long and two inches diameter at its wide end, added to it, as figured at E. To our surprise, no further elevation of the fluid took place. The central current of the blast being received against that part of the vertical tube opposed to it, was, probably, too strongly deflected to allow other portions of the current to sweep close around the horizontal branch. Had the cap D resembled the one marked F, there can be no doubt of the effect being increased, as the wind would then embrace, and impinge upon, a larger surface. Unfortunately we had not prepared any models of cylindrical caps at various angles, i. e., where the caps proper were inclined upwards like F. The next figure exhibits an approach to this plan, and when compared with C, which it so nearly resembles, exhibits a decided improvement.

Experiment IV.—The cap G consists of a vertical tube, with a head piece extending over three-fourths of its upper, or discharging, orifice. The back of the hood, which receives the blast, forms an angle of about 30 degrees with the side of the pipe to which it is attached. This cap raised the water in B from 3½ to 4½ inches, being double the elevation which C produced. Deviating the position of the opening, with regard to the current, diminished the effect.

Experiment V.—The conical cap H was now placed in the blast, upon which the fluid ascended in B from 2½ to 3½ inches. Three models of this cap were tried; they were all of the same diameter at the mouth, and the vertical tubes were attached to them at the same distance from the mouths, viz: three-eighths of an inch; but their lengths varied, being respectively 3, 3⅜, and 3⅞ inches. There were no very observable variations in the altitude of the liquid column produced by them, but the only one that raised it to 3½ inches was the longest—the one last named. When the mouths were turned till the axes of the cones formed an angle of about 45 degrees with that of the blast, the water commonly fell in the tube, though not uniformly so; but what appeared singular, when the axes of the cones were at 90 degrees with the current, the water actually rose to 4½ inches! On several trials this unexpected result followed.

Experiment VI.—The next experiment was with the cap figured at I. The model was made from caps on sale in the city. The outer pipe, or case, was 4⅞ inches long and 1½ inches bore. The inner tube was three-fourths of an inch bore, and with the conical ajutage to catch the wind, 2½ inches long. This cap raised the water 4½ inches. When its axis was a little inclined to the blast, no sensible change in the elevation of the water in B followed; but when the angle with the axis of the blast was at 45 degrees, the water fell to 3½ inches, and at 90 degrees the water stood only at half an inch. (This, and the remainder of the figures, are in section.)

Experiment VII.—The inventor of the last cap has applied near its open end (by two or three strips) a cone, as represented at J. The object of this is to prevent currents of wind entering that end, and so driving the smoke down the chimney, instead of drawing it up. To ascertain the effect of this arrangement on the exhausting power of the cap, the model J was made in all respects the same as I, the cone excepted. On applying it to the current, the water rose in B to an elevation little more than half of that produced by I, being only 2¼ inches. When the cap was turned to 45 degrees, the water fell to 1¼ inches, and at right angles it sunk to a level with that in the vessel. This effect might in some degree have been anticipated, since the wind would, in being thrown from the sides of the tube, be apt to catch hold of the cone, and be turned into the cap. On this account, the base of the cone should not project in the least degree over the mouth. The cone, too, retards the free exit of the smoke.

Experiment VIII.—The next devices tested were such as I have applied to charge siphons, and also for producing a vacuum by currents of steam—the model marked K consisting of a horizontal and perpendicular tube of the same bore, united at right angles. The horizontal one was 2½ inches long. On placing this cap on the glass tube, no rise of the water took place, but rather the reverse, for portions of wind descended and drove out the water occasionally. When the axis was inclined nearly 45 degrees to the blast, the water *rose four inches.* At right angles it was at two inches.

A projecting piece was now placed within the cap, so as partly to cover the orifice of the perpendicular tube; (see next figure, marked L.) On trying this, the water rose 4½ inches; inclining the cap raised it to 5½ inches; as the projecting piece retarded the current through the tube, it was pressed down to make the passage way larger, upon which the water rose a little higher. Various conical ajutages were now tried, as figured at M, and with one six inches long, and two inches diameter at the wide end, the water rose 8½ inches. No additional rise of the column was obtained by changing the position of the cap within the current.

Experiment IX.—The same cap was now tried again, but with the projecting piece entirely removed, (see N.) The water now rose 15 inches, and oscillated from 13 to 15. A short conical tube, whose mouth flared out to two inches, was next inserted into the small end of the cap, with a view to draw more air through it; this caused the liquid column to ascend at once to 18 inches. A longer tube, whose mouth reached to the orifice of A, caused the water to rise entirely out of the tube—28 inches! These increased effects, it will be remembered, are caused by an *interior and exterior* blast—the wind sweeping *over,* as well as *through,* the cap.

Experiment X.—A cap, precisely the same as the last, except the horizontal one, being 1½ inches bore, and as figured at O, raised the water to 18 inches, and kept it oscillating from 16 to 18. The short diverging mouth piece mentioned above, was applied to the receiving end of the cap, and raised it from 22 to 24 inches!

From these experiments it would seem that a chimney cap, or ventilator, made like the last figure, is very far superior in its effects to any other yet known; and, what is of some consequence, the form is almost as simple as the simplest. A diverging tube might be attached to the end which receives the current, but the mouth of this should not greatly exceed the diameter at the junction with the vertical tube; if it did so, it would diminish the effect of the wind, in sweeping along the sides of the discharging branch. The under side of the receiving end of the cap should project beyond the upper one, in order to catch the descending currents more readily. This feature is figured at N and O.

Perhaps some readers of the Journal may find time to repeat and extend these experiments. There are several old chimney caps which have not been included, especially *revolving* ones. At the first favorable opportunity, we will, if not anticipated, pursue the subject.

Notice of the Use of Auxiliary Steam Power in Propelling Vessels.

The small steam engines fitted in the "Vernon" and "Earl of Hardwicke" Indiamen, to try the advantage of small auxiliary power to propel merchant ships during calms and light winds, have been removed. This experiment may, therefore, be considered a failure, for although less time was occupied in the voyage, the loss of room for freight, together with the expense, more than counterbalanced the advantages.

New and Simple Method of Obtaining Mezotint Grounds.

It gives me some pleasure to be able to announce that I can form a tolerably good mezotint ground on a plate, by passing it along with a piece of common sand-paper five or six times through the rolling printing press, with rather a tight pressure. The depth of color, when printed from, does not quite possess the intensity of those executed in the usual manner; but the method answers exceedingly well for prints which it is intended to finish in colors.

I remain, &c.

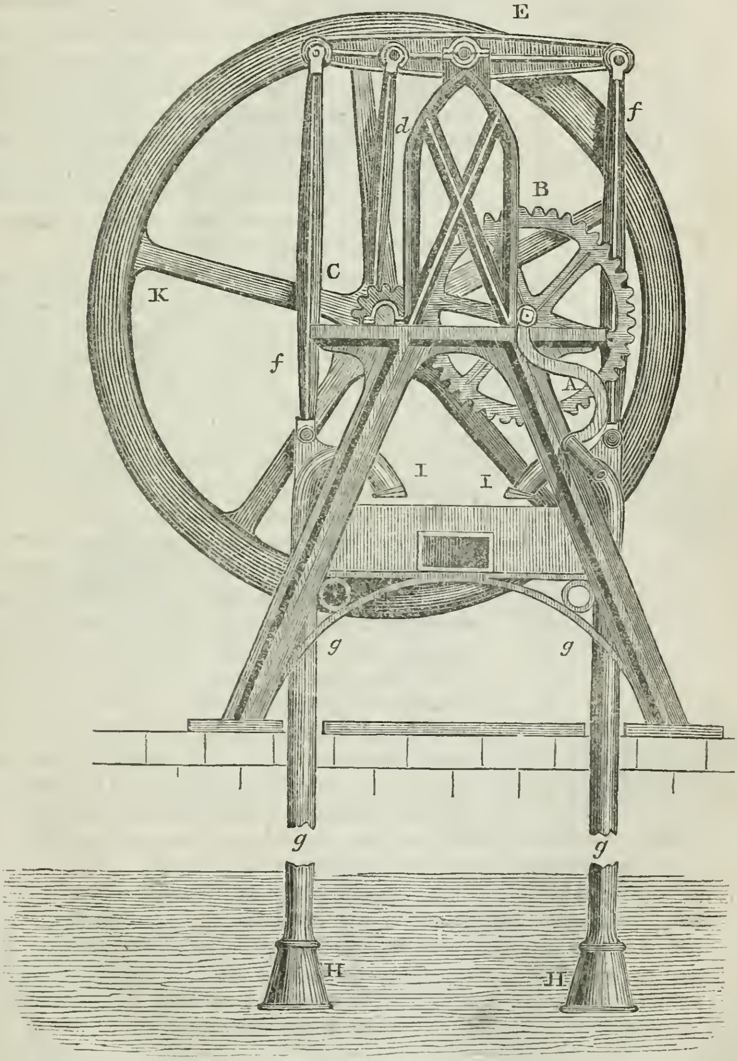
Laurence Brunton.

March 14, 1842.

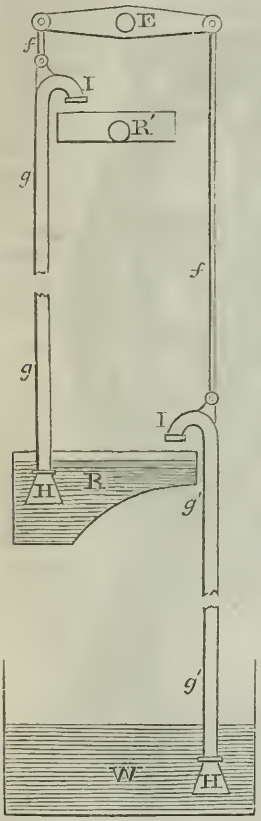
Mech. Mag.

Walker's Hydraulic Engine.

Mr. Walker's apparatus depends for its action upon the momentum acquired by fluids when in motion; several of them have been completed to be worked by manual power, or by wind, and forwarded to climates where machinery for this purpose, constructed of less durable materials, has been found a subject of continual annoyance and expense.



The above engraving represents one of Mr. Walker's Elevators, in its complete form. A is a winch-handle on a shaft, which carries a toothed driving-wheel, B, working into a pinion, C; upon the pinion-shaft there is an eccentric, from which a connecting-rod, *d*, passes up to the over-head beam, E. From each extremity of the beam E, two pump rods, *f*, *f*, pass down to the two elevators, or water cylinders, *g*, *g*, which may be of any convenient length, say from thirty to forty feet, and from one and a half to three inches in diameter; these cylinders are closed at their lower extremity, H, by valves opening upward.



On turning the handle A, a rapid motion s given to the pinion-shaft and eccentric, which has an inch and a half throw; the connecting-rod, *d*, being attached intermediately to the beam, E, a throw of three inches is given to the elevators, which, thus receiving a rapid alternating motion, deliver a stream of water from their nozzles, I, into the cistern, or receptable, from which it flows in any required direction.

The second engraving shows an arrangement for drawing water by means of this apparatus, from wells of a greater depth than could be advantageously accomplished by a single lift. E is the working beam to which two elevators are attached, the first, *g*, *g*, raising water from the reservoir, R, into R′, the former being supplied by the second elevator, *g*′, *g*′, from the well, W.

The pinion-shaft is in some cases fitted with two, three, or more, eccentrics, which give motion to a corresponding number of elevators contained within the same frame, so as greatly to increase the power of the engine, without adding much to its bulk. It will be apparent that as the one elevator, with its contained column of water, is exactly counterbalanced by the other, the machine is constantly in a state of perfect dynamic equilibrium, and therefore the motion communicated to the machinery, and thence to the fluid, produces a direct action, raising the largest quantity of water with the smallest possible expenditure of power.

What the capabilities of this engine may eventually prove to be, remains to be ascertained; in the machines already completed, the quantity of water raised far exceeded the performances of any description of pump hitherto employed; but as none of the machines were sufficiently large to employ the whole power of a man, mechanically considered, no data have yet been obtained upon which to found any calculations.

Mech. Mag.

Improvement in Slide Valves.

Fig. 1 is the section of the cylinder valve, piston, &c. A, represents the piston; B, the piston rod; C, the cylinder; D, slide; E, valve spindles; F, bottom steam passage around the cylinder; G, bottom exhausting passage; K, top exhausting passage; L, top steam passage.

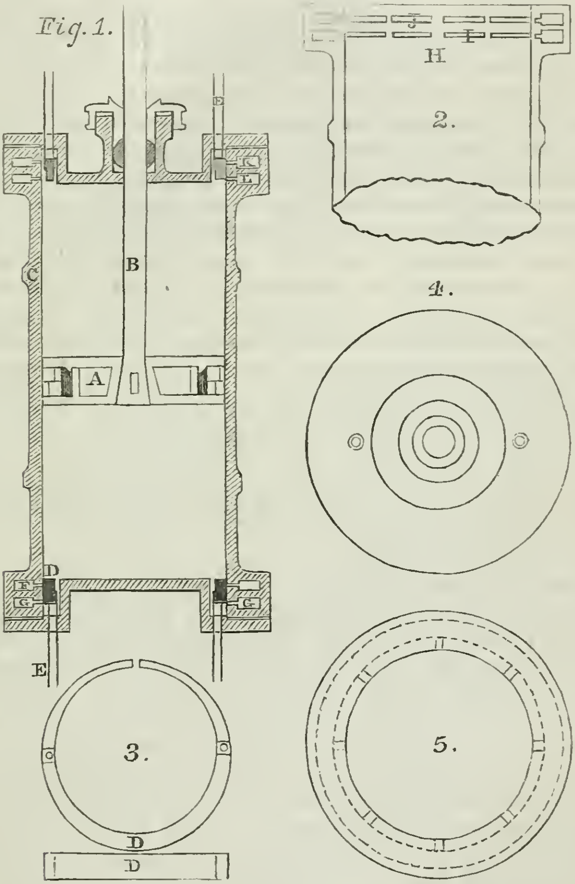


Fig. 2. H is intended to represent a section through the ports, and steam passage, &c.; I, is the steam port; J, the exhausting port.

Fig. 3. D represents the valve, being a round ring.

Fig. 4 is the top view of cylinder cover.

Fig. 5 is top view of cylinder through the ports, showing the ribs.

The utility of this valve consists in giving steam much quicker, in consequence of the ports being all round the cylinder, and the valve traveling, therefore, about one-tenth part the distance of the common D slide valve. It does away, also, with a deal of work, such as the

D valve, valve jacket, packing blocks, &c. The steam may be also, by this means, worked expansively to a greater advantage than at present, as it is necessary to have an additional expansion valve for the present D valve, when it is desired to work steam expansively.

THOMAS MERITON.

Mill Wall, January 27, 1842. Ibid.

New Steam Engine erected by Messrs. Rennie, at Mr. Cubitt's Factory, Thames Bank.

The two-cylinder, expansive engine, invented by Hornblower, and afterwards, with but slight modifications, brought into extensive use by Woolf, is well known to all persons acquainted with the history of the steam engine. The cause, also, of its subsequently falling into disuse, is no secret; it was found to perform no more duty with two cylinders than could be done, at much less cost, with one. Not that more duty was *previously* done with one cylinder, but that in the progress of improvement it was discovered, or supposed to be discovered, that steam could be worked expansively as well with one cylinder as with two; and so the cost of the second cylinder, and the extra friction and radiation attending the use of it, saved. Abandoned in Cornwall, where it first found favor, and long maintained a strong hold on public opinion, it has now, strange to say, been re-produced in the metropolis, by engineers of the first eminence; and, stranger still, with a degree of success which, if there be no mistake in the case, shows not only that it has been most undeservedly shelved by its Cornish patrons, but that it is in truth the best sort of engine which has ever yet been constructed.

The engine which has thus taken the engineering world by surprise, is one which has just been erected by the Messrs. Rennie, at the extensive manufactory of Mr. Thomas Cubitt, Thames Bank. It differs in no respect, as far as regards details and arrangement, from the ordinary rotative engine of Woolf; nor is any such difference claimed credit for by the makers. There are the two cylinders, side by side, as of old—a small one, into which the steam first passes at a high pressure from the boiler, and a larger one, into which it expands (five times;) also the ponderous beam, fly-wheel, rotating shaft, &c. The only difference we could observe, consists in the workmanship, which is of a very superior description, and in a little better clothing (perhaps) of the cylinders. The effective working power is stated to be equal to sixty horses, and the consumption of fuel to be *no more than 2.2 lbs. per horse power per hour.* It is this which is the startling result. So small an expenditure of fuel has never been before reached by any rotative engine, of any description; not even by the same sort of engine, when in the friendly and fostering hands of Woolf. That it has been actually realized in the present instance by virtue merely of better workmanship and better clothing, no person can be expected to believe, except on the most indisputable evidence; and such evidence the respectable manufacturers of the engine will, no doubt, themselves allow, still remains to be furnished. We were assured that it was doing the same work which two or three old engines, of the cumulative power of sixty horses, had been in use to perform, and have no reason to question the fact; but that, evidently, is a very uncertain test of its real power. We were also shown indicator diagrams, which exhibited a very small average deficiency of pressure; but the insides of steam cylinders and working shafts, as all the world knows, often tell very different tales. The means taken to keep a correct account of the quantity of fuel consumed (Welsh coal) appeared to be also most unexceptionable; and if we could only admit sixty to be the proper divisor to employ, we make no doubt of 2.2 lbs. per horse power per hour being a true result. Proof, however, of the sixty horses' power is still wanting—such direct and positive proof as *actual performance* alone can supply, and that not during short trials of an hour or a day at a time, but during trials carried on for several days successively, and under the same circumstances, precisely, in all respects. Ibid.

Condensation of Steam by Cold Air. Craddock's Process.

The peculiar feature of my invention is, the communication of a rapid motion to the condenser—independent, of course, of the motion which the vessel or locomotive may have, to which my condenser is attached. It will be unnecessary for me to detail my preliminary experiments, or the various forms which I have given to the condenser during my investigations; I will, therefore, at once, describe the apparatus in that form which, from my present experience, seems to me the best. A hollow axis is supported by proper bearings, in a vertical position. The lower end, or that at which the steam is introduced, is open, and works on a pivot fixed on the bottom of a chamber, on the top of which is a stuffing-box, through which the axis passes. Near the upper or closed end of the axis is an enlargement, or chamber, from which proceed, at right angles to the axis, a number of radial hollow arms, into each of which the ends of a series of small copper tubes are inserted; these, of course, are parallel to the axis; their lower ends are inserted into other radial arms fixed near the bottom of the axis, and similar to those at top, excepting that their ends do not open into it. The radial arms at the bottom are all connected by their ends opening into an annular chamber. A rapid rotary motion is given to the condenser by the steam engine to which it is attached, the result of which is the cooling of the apparatus, and, consequently, the condensation of the steam which has been introduced into the small copper tubes. The condensed steam, or water, falls into the lower radial arms, and is thrown from thence into the annular chamber by centrifugal force; a small pump is affixed to this chamber, and its piston-rod is attached to the clip of a fixed eccentric, supported round the movable axis of the condenser. As the pump travels about this eccentric, its piston-rod works to and fro, and the water is removed from the condenser. The arrangement of the minor parts of the apparatus, such as the conveyance of the water to the boiler, the connexion of the air-pump, &c., cannot be illustrated without drawings. I may just remark, here, that the force-pump for the removal of the water is not absolutely necessary, as the air-pump may be made to effect that object. My experience, however, demonstrates that it is effected to greater advantage by its use.

I have attached a condenser of this kind to a high pressure engine of five horses' power, and, by giving it a velocity of eleven miles per hour, the water is drawn off at a temperature varying, with that of the air, from 90° to 120° Fahr. The column of mercury supported by the vacuum is not quite so high as it should be, according to the temperature of the water; this, however, is owing to the imperfection of some of the joints in the condenser, and will soon be remedied. The power gained is more than double that required to work the condenser and air-pump. The amount of surface required to condense a given number of cubic feet of water per hour, depends on the velocity at which it is intended to work the condenser, and the temperature at which the water is drawn off. It does not appear to me advisable to draw the water off at a temperature lower than 150°, for a given abstraction of heat at lower temperature affects the height of the mercurial column much less than at a higher; and any one familiar with the law according to which heat passes from one body to another, need not be told that the same surface will condense much more steam into water at 150° than at 100°. A condenser having a velocity equal to twenty miles per hour, and the water being drawn off at 150°, will require about twenty square feet of surface per cubic foot of water per hour. The strength of the copper I have hitherto used is one pound to the square foot, but I intend using it much lighter in future. The weight of a condenser equal to condense ten cubic feet of water per hour, will be from eight to ten hundred weight.

Besides the advantages which my mode of condensation possesses, in those situations where a supply of water cannot be had, I believe it possesses other, and scarcely less important, ones. By my condenser returning the water to the boiler, I am enabled to use a tubular boiler, without experiencing that inconvenience which almost precludes their use, in combination with the ordinary system of condensation, namely, the liability to become choked up by the deposit from the water. Although the condenser with which I am working is far from being tight in its various joinings, I have worked my engines constantly for four days, without adding any water to the boiler; and I have no doubt that the condenser and engine I am now fitting up, and to which I hope very soon to be able to call the attention of engineers, will give results even more satisfactory than those at present obtained.

THOMAS CRADDOCK.

Ibid.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1841.

With Remarks and Exemplifications by the Editor.

1. For improvements in machinery for *Hoisting Weights, &c.;* John B. Holmes, Boston, Massachusetts, June 7.

In this machine the rope, or chain, to which the weight is suspended, winds around two grooved drums, to each of which there is attached a cog wheel, mashing into a pinion that lies between the two, and by which they are actuated, the two cog wheels having the same number of teeth, to insure the same motion to the two drums. These drums, together with their cog wheels, project outside of the frame, one of them turning on a spindle attached to the side of the frame, and the other on a spindle which passes entirely through it—the part of it which is within the frame being adapted to receive one of a train of wheels for multiplying the power. One of the drums has cogs cut upon its outer edge, which take into the teeth of a pinion on the axle of a grooved roller, for the purpose of making pressure upon the rope, or chain, to prevent its slipping.

Claim.—"What I claim as my invention and improvement, and desire to secure by letters patent, are—First, the arrangement of the barrels which hold the rope without an outside framing, as described. Second, the combining therewith, in the manner set forth, a grooved roller, to press the rope against the barrel on its passage therefrom, for the purpose of preventing any slipping of the rope which the action of the weight at the other end has a tendency to produce—being constructed and operating as described."

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2. For an improved mode of *Block Printing* on various kinds of Fabrics, and for Apparatus, &c., for that purpose; Robert Hampson, Manchester, England, June 7.

The printing block is attached to a cross frame, which slides on straight edges at the four corners of the main frame, and has a rod attached to its middle that slides through a hole made in a set of arms at the top of the main frame. To the upper end of the rod there is a band attached, which passes over two pulleys, and has appended to it a counter weight, to balance the whole.

The fabric to be printed is drawn through the machine, and over the bed on which it rests, to receive the impression, which is given by means of blocks, in a manner well known to machinists. The colors are so arranged in separate sieves as that they can be drawn apart to receive new colors, and then brought together again to apply the colors to the block; the sets of sieves are placed upon a platform provided with wheels, running on rails. The platform, with the colors, is passed under the block, which is then let down to receive that which is wanted. The sieve is then drawn away, and the block descends upon the fabric, to impress the pattern; and the operation is in this manner repeated.

Claim.—"I declare that I claim as of my invention the apparatus, or machinery, constructed as set forth, for printing with blocks on woven fabrics of various kinds; that is to say, I claim the combining of a block for printing in various colors with the apparatus, or mechanical agents, for causing said block to descend in a perpendicular direction in order to take up the color from the sieve, or sieves, and to impress the pattern, or design, upon the fabric; said apparatus, or mechanical agents, consisting of the cross frame, the arms, the straight edges at the corners of the main frame, the rod, the band, and counter weight, with their appendages; the whole being so connected as that by raising the counter weight the cross frame and block will descend, and the color be received on the block, or the impression given to the fabric; and I claim the same however the said mechanical agents and contrivances may be modified or varied in size, form, proportion, or other particulars not departing from the principle of my invention; but I do not claim as my invention such mechanical agents, or contrivances, separately, but only as combined to effect the purpose aforesaid; nor do I claim as part of my said invention the apparatus hereinbefore described for traversing the coloring apparatus to and fro, by means of a railway and carriage running thereon—the same, although invented by me, having been by me used and practised previous to the grant of the said letters patent; nor do I claim as of my invention the arrangement of rollers and connected apparatus for causing the fabric to traverse, or be drawn over, the printing table, and conveyed away when printed. And I further declare that I claim as of my invention such coloring apparatus as hereinbefore described, in which several sieves are separated and held apart, to admit of the several colors being distributed and traced, or spread, thereon, without admixture or interference one with another, and whereby the sieves are afterwards closed, or brought into juxta position, in order to the colors being taken up by the block, so as to produce at one impression of the block, or pattern, or design, or parts of a pattern or design, in several colors, arranged contiguous, or near to each other, as hereinbefore described; and which coloring apparatus I claim, whether the same be used in conjunction with the machinery before described, or with the common hand block, or otherwise, and under whatever other modification."

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3. For an improved mode of Framing and *Bracing the Arms of Paddle Wheels* of Steam Vessels; Wm. F. Julian, Hartsville, Bartholomew county, Indiana, June 7.

The arms are bolted to a cast iron centre plate, in the usual manner, and kept at equal distances apart, by wedges driven in between them. Two sets of braces are arranged between the arms, the braces being provided with short tenons, fitting into long mortises in their sides, the said mortises being sufficiently long to allow the braces to be drawn in towards the centre of the wheel. The two sets divide the length of the arms, between the periphery of the outer plate and their outer extremity, into three parts. The centre plate has a flanch with notches, into which the arms fit, and the braces are drawn tight towards the centre of the wheel, by means of radius screw bolts that pass through their middle and the flanch of the centre plates.

Claim.—"What I claim, and desire to secure by letters patent, is the within described manner of inserting and drawing up the braces, by means of brace-bolts attached at their inner ends to the circular plate which receives the ends of the arms; said bolts being furnished with screw nuts, which are to bear against the middles of said braces, as described and represented; the braces being inserted and retained in place by means of short tenons, and left free to slide within the arms, as set forth. I also claim, in combination with the foregoing mode of bracing by means of the brace-bolts, the employment of the wedges between the inner ends of the arms."

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4. For an improvement in the machine for *Turning Straight, Curved, or Taper, Work*—such as Fork and Shovel Handles; Collins & Wistar, assignees of Stacy Costill, Philadelphia, Pennsylvania, June 7.

The piece of wood to be turned is fixed to a mandrel, and passes through a hole in a plate attached to a slide rest. The hole in the plate is provided with three segments that slide in radial grooves made in the plate for the purpose of regulating the size of the hole to suit the size of handle required to be turned. The segments are all moved together by a second plate, which has three eccentric grooves cut in it, that receive projections from the back of the said segments. The turning of the last mentioned plate at the back of the main plate will, therefore, cause the segments to approach or recede from the centre. The cutting is effected by a cutter attached by proper fixtures to one of the segments.

Claim.—"What I claim as of my invention, and desire to secure by letters patent, is the cutter in combination with the movable segments, and these thus combined in combination with the eccentric grooves in the plate, for the purpose, and in the manner, described."

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5. For an improvement in the *Key for Extracting Teeth;* Moses J. Hill, Bloomfield, Lagrange county, Indiana, June 7.

This patent is granted, as stated in the claim, "for combining a friction roller with the bolster of the ordinary key for extracting teeth, in such a manner as that said friction roller shall constitute the bearing part of the bolster in the operation of extracting a tooth."

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6. For an improvement in the *Saw Mill;* James B. Lowry and Philander Eggleston, the former of North East, Erie county, Pennsylvania, and the latter of Mayville, Chatauque county, New York, June 11.

This patent is for an alleged improvement on that kind of saw mills in which two saws are used; but instead of being strained in a gate, they are attached to chains that are connected with two vibrating beams, the ends of which are segments of circles. The claim is confined to the combination of a slide and stirrup, by which the saws are attached to the chains, and by which they are guided.

7. For an improved mode of *Fastening Doors on the inside*, called the "Traveler's Security;" Benjamin H. Green, Princeton, Mercer county, New Jersey, June 11.

This instrument is for fastening doors from the inside which are not provided with locks or bolts. Two claw pieces, one of which is put against the floor, and the other against the lower rail of the door, are united together by a right and left handed screw, provided with a thumb piece in the middle for turning it, and by which the claws are forced apart.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of constructing the traveler's security by combining the two claw pieces with an intermediate screw, furnished with a thumb piece for turning the same, as described."

8. For an improvement in the *Bee Hive;* James Le Pataurel, Chandlersville, Muskingham county, Ohio, June 11.

The proposed improvement is in that kind of hive in which the honey is formed in glasses, and by which the patentee says he is "enabled to take out the honey, &c., from the hive, without destroying the bees, and without running any risk of being injured by them." The glasses are made with a stem which fits a hole in the cover of the hive, and are provided with a hole at top, and they are arranged in pairs at a suitable distance apart, to receive two pipes that branch out from a furnace for generating smoke. When it is desired to drive the bees from a set of glasses into the apartment below, the pipes are applied to the glasses, and a composition, consisting of 3 oz. of sulphur, 4 oz. of pitch or tar, 1½ oz. of tobacco, and ¼ oz. of grease, is put into the furnace, which generates a smoke that expels the bees. The glasses are then removed, and the holes closed by means of movable covers. When it is desired to drive the bees from one apartment to another, the pipes of the furnace are introduced through holes in the cover of that apartment from which they are to be driven.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the manner in which the glass bows, or hives, are combined and adapted to the apertures in the cover, by being formed with hollow stems, as set forth. I also claim the furnace constructed and combined with the hive, as set forth."

9. For improvements in *Door Locks and Latches;* Geo. W. Wilson, Nashua, Hillsborough county, New Hampshire, June 11.

The claim in this patent rests upon the making of the lever, which acts upon the latch, with a heavy weight and disconnected from the latch, so as to cause it and the knobs to return to a stationary position, and thereby, whenever the door is closed, to permit the latch to recede and advance independently of said lever; and also to the combination of this with a weighted, or gravitating, latch; to the combining with the main bolt of the lock another bolt, to be operated by an extra key; and to constructing the holding lever of the main bolt so that the key cannot be withdrawn unless the holding lever has been brought to its proper place; and, finally, to a peculiar apparatus for giving an alarm should any one attempt to open the lock; this apparatus consists of a slide, spring, and spring catch, to be used in connexion with the extra bolt, and which, when disconnected therefrom, starts the alarm.

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10. For improvements in the *Horse Power;* Samuel H. Little, Gettysburg, Adams county, Pennsylvania, June 10.

The patentee informs us that the improvements consist in the "manner of constructing this machine, by which it is made capable of being adapted to the power of two or four, or any other varying number of horses." The rim of the main driving wheel, with the cogs thereon, is cast separately from the arms, by which it is connected to the shaft, there being gains, or notches, cast in the inner side of said rim, into which the ends of the arms fit, and by which it is capable of being removed from one set of arms, and placed upon another set, of the same size. Immediately over the arms above named, and connected with them, are the sunken troughs which receive the horse sweeps. The weight of the wheel, arms, &c., is supported by conical friction rollers, which have their bearings in braces cast with the said arms. This wheel revolves on a stationary pivot rising from the cap of the machine, and gears into a pinion on the shaft of the second wheel. The upper ends of the shafts of the second and third wheels are adapted to receive the main wheel when it is desired to employ less power. The lower gudgeon of the shaft of the second wheel is received in the upper part of a standard projecting from the bed of the machine, and this standard is also adapted to the reception of a shaft, instead of this, provided at its upper end with arms and troughs for the horse sweeps; and at its lower end with arms for the main wheel; the said arms being also provided with conical friction rollers that travel on the upper part of the standard, which is made conical for that purpose. By these various arrangements this machine may be conveniently and readily adapted to the power of one, two, or more, horses.

The claim makes reference to the drawings, and is to the manner in which the cross, or troughs for the sweeps, the arms and rim of the driving wheel, and the friction rollers, are arranged and combined, so that they may be shifted from one shaft to another, and by which the wheel may be adapted to other arms of the same size; and also to the manner of arranging the extra shaft so that it may take the place of the shaft of the second wheel.

11. For improvements in *Marine Steam Engines;* Charles W. Copeland, New York, June 11.

The cylinders, in this arrangement of the engine, are inclined at an angle dependent upon the depth of the hold, and the length of stroke; and they are fastened to inclined beams extending from the paddle-wheel shaft to the kelsons, said beams being connected with the kelsons along their whole length, by other beams, and by bolts—the whole constituting truss-frames, which sustain and divide the weight and jar of the engines. The condensers are directly under the upper end of the cylinders, and the channel-plates run between the kelsons. The lower end of the air pumps, which are inclined, as well as the cylinders, are secured to the ends of the said channel-plates, and the hot wells to their upper parts; the delivery valves are placed on the upper side of the channel-plates. The pistons of the air pumps, in this arrangement, are solid; and the whole apparatus is rendered compact, and placed within the reach of the engineer. The side pipes are placed above the cylinders, the steam chests at each end thereof, and the valve stems running down in front of the heads of the cylinder to the rock shaft. The feet are attached directly to the stems, instead of lifting rods, and are acted upon by the toes of the rock shafts, the two rock shafts being connected together by a rod.

Claim.—"What I claim as new, and as constituting my invention, is, first, the placing of the cylinder in an oblique direction, with its lower end near to the bottom of the vessel, and allowing it to stand at such angle as is required for the connecting of its piston rod with the crank on the shaft of the paddle wheels, in combination with the condenser, channel-plate, and air pump, arranged and located as described. I do not claim the mere placing of the cylinder of a steam engine obliquely, as this has been done for other purposes; but as I produce a new and useful effect, by so placing the steam cylinder and its appendages in the combination above claimed, on board of vessels for navigating the ocean, I limit my claim to the so placing them under the said combination as to attain the object fully made known. Secondly, I claim the manner of arranging and working the steam and exhaust valves as set forth, the same being effected by a direct action, that is to say, without the employment of the lifting rods and lifters usually required for that purpose. Thirdly, I claim the manner of combining and arranging the condensing apparatus, the air pump being placed at the same angle, or nearly so, with the cylinder, and attached by its lower end to the channel-plate, the delivery valve being also placed on the upper part of the said plate; the combination intended to be claimed under the last head consisting in the arranging of the several parts enumerated, that is to say, the air pump, the channel-plate, and the delivery valve, substantially in the way described."

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12. For an improvement in the *Fulling Mill;* Sidney E. Coleman, West Haven, Rutland county, Vermont, June 11.

The cloth is put into the machine, with the usual folds, and passes between rollers arranged in a box, which have different degrees of motion communicated to them by band wheels and bands, or by cogged wheels.

Claim.—"I claim as my invention, fulling cloth by means of revolving rollers, or cylinders, said rollers being arranged in a box, or casing, and operating as described."

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13. For an improvement in the *Saw Mill;* William Bryant, Nashville, Tennessee, June 11.

The saw gate and fender posts of this mill are placed at an angle of about 45 degrees with the plane of the carriage, instead of being perpendicular to it.

Claim.—"What I claim as my invention is, placing the guides which direct the saw at such an angle with the log, or timber to be sawed, that the shavings in being cut are peeled, or raised, and carried forward by the teeth of the saw, in the lengthwise direction of the timber sawed."

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14. For an improvement in the *Rotary Steam Engine;* Hernon Smith, Sunbury, Delaware county, Ohio, June 11.

In this rotary engine there are two pistons on opposite sides of the wheel, or drum, each being united by a rod passing through the diameter of the wheel, said rod being provided with a loop in the middle, to pass over, and slide on, the shaft. This double piston is operated, or shifted, during the rotation of the wheel, by means of a cam on its outside, which cam is a semi-circle, with the ends running out from the circle to catch a pin on the piston, and thus shift it.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the peculiar form and construction of the double piston moving over the shaft, in combination with the semicircular cam outside the steam chamber, as described, for changing the position of the pistons as the wheel revolves."

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15. For an improvement in the *Lamp for burning Oil and Camphine;* Christian and Charles Richman, Philadelphia, Pennsylvania, June 11.

The wick tube of this lamp, which is on the principle of the Argand, is provided with two holders that are jointed to the lower end of the tube, their upper ends being semi-circular, and made to hold the wick against the upper end of said tube. This holder slides on the inner cylinder of the lamp, a pin on its inner side passing into a groove on the outside of the cylinder; and on the outside of the holder is placed the runner, which has a spiral groove running from its upper end to near the bottom, into which fits a pin from the wick holder, so that by turning the runner the wick holder will be made to rise or sink vertically. The upper end of the runner is connected with the glass holder. The button is made conical and of glass, instead of being flat and of metal.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manner in which we have combined the wick tube with the runner and internal cylinder, which is to say, we claim constructing the runner with a spiral, as set forth, in combination with the internal cylinder having a vertical groove and the wick tube arranged between them, by the combined action of which revolving spiral and stationary groove, the wick tube and wick are raised without being turned, as in the ordinary astral lamps. We also claim the manner in which we have combined the clasps with the wick tube, by forming it into two parts, and connecting them by hinges to the bottom of the tube, as set forth. Lastly, we claim the employment of a conical glass button in lamps for burning camphine and other oils."

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16. For an improved *Apparatus for, and mode of, Feeding Silk Worms;* Edmund Morris, Burlington, New Jersey, June 16.

The feeding frames are made of strips of wood, arranged at proper distances apart in a frame, the two hind corners of which fit into grooves made in the sides of two uprights; about twelve inches above each frame is placed the roof, consisting of a frame with cords stretched across it, to sustain a layer of straw, and a cover, to catch the dirt which falls from the feeding frame, which stands three inches above it. In this manner the feeding frames and roofs are arranged one above the other. A fork is used, called a "cleaner," for the purpose of lifting the material on which the worms have been feeding: this cleaner consists of a bar, provided with two handles, one near each end, and ten or more prongs.

Claim.—"I claim the manner of constructing the above described apparatus, or frame, for feeding silk worms—that is to say, I claim the combining together of a series of feeding frames and of roofs, by sliding the end pieces of the same, extended out for that purpose, into grooves made in uprights, which may extend from the floor to the ceiling of the room; said feeding frames and roofs having such uprights at their backs only, and forming a continuous and unobstructed range in front of them, along the whole, or any desired portion, of the apartment, without the intervention of uprights, or supports of any kind, so as to admit of the operations of feeding and cleaning being carried on with perfect facility, the respective parts being arranged and combined substantially as set forth. I claim the method of cleaning the worms, when necessary, by the employment of the cleaning fork described, by which I lift at once the entire surface on which the worms may be feeding, so as to clean them without waiting, as the practice has been, for the worms themselves to mount up into fresh foliage, and so as to allow the mass, stems, and foliage, to be promptly removed. I claim the within described manner of forming the portable straw spinning roof, in which the worms are to form their cocoons, and by the portability of which I am enabled to identify the age, from the spinning, of any number of cocoons, the gathering of which is thereby greatly facilitated, while their value is not endangered by being kept too long ungathered; the said spinning roof serving the double purpose of catching the litter from above as it falls from the frame, and of affording a suitable place for the worms to spin in as they rise from the frame below."

17. For an improvement in the *Spark Arrester*, for the Chimnies of Locomotives, and other Steam Engines; Richard French, Philadelphia, Pennsylvania, June 16.

The chimney is surmounted by a concave cap, placed a short distance above its upper end, sufficient room being left for the draught. The whole is surrounded by an outer casing, which forms a receptacle for the sparks which are thrown down by the cap. The top of this outer casing is formed of perforated concentric sheets, or hoops, of metal, arranged as expressed in the claim, which is in the following words, viz:

"What I claim, and desire to secure by letters patent, is the manner described of arranging and combining the hoops, or bands, of perforated sheet metal, or of wire gauze, by uniting them at their upper and lower edges, alternately, so as to produce continuous perforated surfaces of great extent; between which surfaces concentric circular spaces are left when the instrument is made circular, as is usually done. I also claim the combining with the foregoing apparatus of perforated hoops, bands, or plates, a disk, or cap, interposed between the top of the chimney and said system of perforated hoops, or bands, for the purpose made known."

18. For improvements in the *Plough;* David Prouty and John Mears Boston, Massachusetts, June 16.

These improvements are for a mode of uniting a double reversible point, or nose, with the share, or wing, and the two with the mouldboard, in the manner expressed in the claim, which follows, viz:

Claim.—"First, we claim arranging, or connecting, the invertible nose and ring together, by means of suitable grooves on the side of the former, and the corresponding angular, or wedge-shaped, sides of the latter, fitting into the grooves as described; and we also claim imbedding the invertible wing and nose, or point, upon the mouldboard, and confining them in their positions by means of a cap, having projections and grooves corresponding with those of the said invertible parts; the cap being rebated to the plough share, so as to have its upper face a continuation of the curved surface of the same; the whole being confined together by a bolt, or bolts, and nuts, as described."

19. For an improvement in the *Grates of Cotton Gins;* Albert Washburn, Bridgewater, Plymouth county, Massachusetts, June 16.

This improvement is intended to obviate the necessity of renewing the grates of cotton gins in consequence of the wear which takes place at the part where the saw teeth pass, by making a dovetail groove to receive a piece of metal, glass, or hard wood, which may be taken out when worn, and renewed without the necessity of even moving the grate.

The claim is confined to this manner of construction.

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20. For an improvement in the machine for *Trimming Books, Cutting Paper, &c.;* Frederick J. Austin, New York city, June 16.

The books, or paper, to be cut or trimmed, are secured in a press of the usual construction; and the knife by which the cutting is effected receives a double motion, which causes it to give a drawing cut, thereby cutting more smoothly and easily than if the cut were directly vertical. The knife is attached to a frame, which is provided with what the patentee calls "inclines, or cams," which slide against similar cams attached to the frame of the machine. This knife frame is connected by means of two jointed connecting rods, with a vertical sliding frame at the bottom, that receives motion from two pinions on an arbor, the teeth of which take into the teeth of two racks attached to the frame. As the lower sliding frame moves down, it draws with it the knife frame, which at the same time receives a lateral movement by the inclined ways, or cams, at the side.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar mechanical combination used to give a lateral, or sliding, motion to the knife, which consists of the inclines, or cams, formed on the knife frame working on the cams attached to the frame of the machine, the connecting rods, and the lower sliding frame, for the purpose, and in the manner, specified. Also, I claim the mechanical construction of the press, as arranged and combined with the parts for cutting, thereby forming an entire machine for the purpose described."

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21. For an improvement on his *Self-acting Log Brace for Saw Mills;* Benjamin Cushwa, Clear Spring, Washington county, Maryland, June 19.

This improvement is added to a patent granted to Mr. Cushwa on the 15th of July, 1840, and noticed in this Journal, vol ii, 3rd series, page 203.

The improvement claimed is, for the addition of a ferrule with a flanch on to the roller of the log brace, which supports the log, as previously patented; which ferrule and flanch may slide on the said roller, and be set nearer to, or farther from, the line of the saw. The object of this improvement is to prevent the springing of the log—an effect which generally takes place after a slab has been cut from it.

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22. For an improvement in the process of *Burning Lime;* Samuel Garber and Henry Swartzengrover, borough of Norristown, Montgomery county, Pennsylvania, June 19.

The improvement above referred to, is added to a patent granted to the same persons, on the 25th of March, 1837, and is fully explained in the following claim, viz:—"We claim as our improvement in the calcination, or burning, of lime, the introduction of heated air into a lime kiln, for the purpose of burning or calcining the lime contained therein; and this we claim by whatever means the air may be heated, and whether the lime is or is not intermingled with fuel in the kiln."

23. For an improvement in the *Slides of Extension Tables;* Charles F. Hobe, city of New York, June 22.

The slides in these improved extension tables are to be plated with metal, and arranged in such manner as to give a longer bearing than is attained by means of the common dovetail slides. Each side of a slide is grooved for about two-thirds its length, the groove commencing on the two sides at opposite ends. These grooves are covered with plates, having slots in them, running nearly the whole length. On each side of the slide, and at that end of it which is not occupied by the slots, there is a T shaped piece of metal, which slides in the slot of the adjoining slides. The slots are enlarged at one end, to admit the T shaped piece, and this enlargement is then closed by a piece of metal which is held by a screw. By this arrangement, each side of each slide is connected with the adjoining slide, in two places, its T piece on one end, fitting into the slot of an adjusting slide, and a slot on the other end receiving the T piece from the adjoining slide; the same connexion being repeated on each adjoining slide.

The claim to the foregoing arrangement refers throughout to the drawings.

24. For a new *Composition for Coating Metals, to prevent Corrosion;* Arthur Wall, Shadwell, England, June 22.

(See Specification.)

25. For improvements in the *Washing Machine;* H. R. Walter, Norwich, Chenango county, New York, June 22.

In this washing machine "the clothes to be washed are placed upon a fluted board, which lies horizontally within a trough, or cistern, containing the suds, or water, by which the cleansing is to be effected. Over this board, and upon the clothes laid upon it, a fluted roller is to be passed back and forth, which roller revolves in suitable head-blocks, and is pressed down by the action of spiral springs, so as to enable it to yield to the inequality of thickness in the articles to be washed. The roller is surmounted on its upper side by a plate of sheet metal, which extends from one head-block to the other, and with them constitutes a frame for containing the fluted roller. This fluted roller frame is held down, as it traverses back and forth, by guide pieces attached to the sides of the cistern, and which enter into grooves made on each end of the frame to receive them."

Claim.—"What I claim is the manner in which I have constructed the fluted roller frame, and combined the same with the trough, or cistern, as herein set forth; that is to say, I claim the arranging of the fluted roller so that its gudgeons shall be received in sliding rods, which are acted upon by spiral springs contained in two head-blocks, are connected together by a cap, or covering, which incloses the fluted roller; the whole being constructed substantially in the manner described. I claim, also, the combining of the said fluted roller frame with the cistern, by means of ledges attached to said cistern, and received within grooves on the head-blocks, said grooves being furnished with friction rollers on their lower sides, and the roller frame being made to work back and forth horizontally, upon a horizontal wash board, for the purpose, and in the manner, described."

26. For an improvement in the *Water Wheel* for Mills; Nelson Johnson, Triangle, Broome county, New York, June 22.

The patentee calls this an "improved direct percussion and reaction water wheel," that is to say, the wheel is to be actuated by the striking of the water upon the buckets, aided by the reaction as the water leaves them at the bottom. The outer rim of this wheel is conical, with a flanch curving outward at the lower edge, and the inner rim is in the form of the lower section of a bell. These two rims are connected together by curved buckets, the outer rim being scolloped, to correspond with the upper, inclined, curved surface of the buckets. The inner rim is lower than the outer, so that the buckets incline downwards, towards the shaft, as well as in the direction of the circumference.

"What I claim as my invention is the manner in which I have combined the buckets with the inner bell-shaped rim, and outer conical rim, by forming the scollops in the upper edge of said outer rim where the water enters, instead of in the lower edge of said rim, where it discharges, as in my original improvement; and combining one edge of the buckets with the scollops thus arranged, and the other with the inner bell-shaped rim, as set forth."

27. For an improved mode of *Setting up Printing Types;* James Hadden Young, of England, and Adrain Delcambre, of France, June 22.

This invention consists in a machine, or apparatus, for what is technically called composing, or the setting up, of types for the purpose of printing; by its means the letters are to be placed in their proper order, as in the composing stick, in a much more rapid manner than heretofore; this is effected by means of an inclined plane, or inclined planes, upon which the types are thrown, and allowed to descend by various channels, which meet in one point, at the composing box, which supplies the place of the ordinary composing stick. There are a number of keys, somewhat similar to those of a piano forte, which act upon levers that push the types on to the inclined plane, or planes, down which they descend by their own gravity, to the said box, whenever the keys are depressed; such types being so pushed out of boxes, or cases, made to contain them. The types are arranged in the composing box side by side, and then removed by hand to the chase, in the usual way.

There is a groove for each letter of the alphabet, the entrance to which is governed by what is called a pushing frame, in connexion with a key having a corresponding letter marked upon it. These grooves are all arranged side by side on the inclined plane, and are covered by a covering plate, to prevent the types from jumping out. The types are arranged in cases, consisting of inclined channels, and each channel is in connexion with an appropriate groove, and when the proper key is acted upon, the pushing frame forces the lowest letter out of the channel into the groove, down which it descends to an aperture, provided with a spout, which insures the proper delivery of the letter in the composing box; and at the reception of each letter, a combination of levers, acted upon by the keys, causes all the former letters to be pushed forward for the reception of the next.

Claim.—"We hereby declare the inclined plane, the pushing frame, the covering plate, our new composing box, and the movements connected with the said box, to constitute our said invention, for which we hereby claim to maintain exclusive right and privilege, by means of letters patent.

28. For an improvement in the *Lamp for Burning Lard;* Edward T. Williams and Latham T. Tew, Newport, Rhode Island, June 26.

The body of the lamp, or stand, is cylindrical, and within it a piston is fitted, for the purpose of forcing the lard up to the wick. Two screws pass through the said piston, and extend down to the base of the lamp, and are each provided with a pinion, the teeth of which take into the teeth of a small cog wheel, which has an axle adapted to the reception of a key fitting into it from the under side of the base, or stand. Under this arrangement, the turning of the key will actuate the screws, and thus work the piston up or down.

The claim is to the method of feeding the lamp, or elevating the lard into the reservoir which contains the wick, by means of a movable piston in the tube, or neck, of the lamp, arranged and operated in the manner described.

29. For an improvement in the *Spark Arrester* for Locomotive and other chimneys; Leonard Phleger, Philadelphia, Pennsylvania, Assignee of W. W. Hubbell, Moyamensing, Philadelphia county, Pennsylvania, June 26.

In this apparatus, the spark arrester and the receptacle for the sparks, instead of surrounding the chimney as usual, is placed alongside of it, and they are made to communicate with each other at, or near, the top—the latter being of greater diameter than the former. Within the tube of the spark arrester there is a perforated tube of less diameter and length, so as to leave a space all around, between the two, and at the bottom. The perforated tube, where the arrester receives the draught, smoke, sparks, &c., is covered with solid sheet metal, for the purpose of scattering the sparks. The top of the chimney is provided with a cap, which may be removed whenever it is not desired to make use of the arrester. The space between the outer and the inner perforated tube is covered, so that the draught must pass through the perforations in the inner tube, the sparks being retained in the space between the two.

By this arrangement, we are told by the patentee, that "the chimney is not rendered top-heavy, a less surface than usual is exposed to the action of the wind; advantage is also derived from the large surface of the casing which is exposed to the action of the external air, which condenses a portion of the exhaust steam which is passed into the chimney as usual, and is forced along with the sparks, into the space between the outer and inner tubes."

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the chimney and the spark arrester and depositor; the chimney not being surrounded in any part by the arrester, but the two being placed side by side, and communicating with each other at their upper ends; and the arrester and depositor consisting of an outer case, an inner perforated, or wire gauze, cylinder, or tube, with an imperforated part where the draught first strikes it; and having a receptacle for cinders and ashes at its lower end, as described."

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30. For an improvement in the *Spark Arrester* for Locomotive and other chimneys; Leonard Phleger, Philadelphia, Pennsylvania, Assignee of W. W. Hubbell, Moyamensing, Philadelphia county, Pennsylvania, June 26.

The chimney, in this arrester, is surrounded by a perforated cylinder, and the whole by a jacket, which extends down lower than the said perforated cylinder, but not quite so low as the chimney. The chimney is provided with a movable cap, as described in the preceding notice; and the space between the perforated cylinder and jacket is permanently covered with a cap. Near the top, the chimney communicates with the outer space, by means of pipes that pass through the perforated cylinder, so that the draught passes from the chimney into the outer space, and thence, through the perforations in the cylinder, into the space between the chimney and perforated cylinder, and out at the top.

Claim.—"I hereby declare that I do not claim to be the first inventor of either of the separate parts thereof individully, but I do claim to have so combined and arranged these parts as to have produced an instrument substantially new in its character, and beneficial in its effects; that is to say, I claim the surrounding of the chimney by the perforated metallic cylinder, or cone, and the jacket, or case, combining these parts together, and inclosing them in the manner set forth; the chimney being furnished with a cover, or shutter, and tubes, or pipes, of communication extending from said chimney into the outer space; and the other parts concerned in the action of the apparatus, being arranged substantially in the manner, and so as to produce the results, set forth."

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31. For an improvement in the *Spark Arrester*, or Depositor; Leonard Phleger, Philadelphia, Pennsylvania, Assignee of W. W. Hubbell, Moyamensing, Philadelphia, Pennsylvania, June 26.

In this instrument, the smoke box is surmounted by a drum, and upon this is placed the chimney, which is connected with it by means of a hinge, to admit of passing under bridges, &c. Within the drum is placed a cylinder of perforated metal, or wire gauze, which is closed at its lower end by a plate of solid metal, with a hole in the middle, surrounded by a flanch projecting downwards, for the reception of the exhaust steam pipes, the upper end of the said cylinder being left open. Within the drum there is a belt, or zone, of perforated metal, or wire gáuze, united with it at its lower end, and which extends up conically and is united with the upper end of the perforated cylinder, by an annular plate which closes the space between the two. In the space between the perforated cylinder and zone, there is an imperforated casing, or tube, which extends from within a short distance of their upper ends, to the top of the fire box, a part of it being within, and the rest below the drum, the lower end of which is inclined and connected with the said case by an annular plate, that forms an inclined plane, to cause the sparks which fall upon it to descend into a box at the side. There is an inclined pipe which runs down from the inclined lower end of the drum to the box or receptacle for the sparks; this pipe is divided into two parts by a perforated diaphragm, extending its length, and dividing it into an upper and lower space; the upper space being connected with the upper part of the drum by a pipe. Within the perforated cylinder is an imperforated tube, open at both ends, (and supported by stays,) for the purpose of directing the exhaust steam immediately up the chimney, and to prevent it, by its expansion, from impeding the passage of the draught through the perforations in the cylinder.

Claim.—"What I claim as new, and desire to secure by letters patent, is the particular manner in which I have combined and arranged the respective parts, as set forth; that is to say, I claim, in combination, the perforated cylinder, and the perforated belt, or zone, connected with each other by means of an imperforated annular plate, the lower edge of the zone being connected to the drum, as described and represented. I also claim, in combination with each other, the arranging of the inclined annular plate of metal, the tube leading to the box, the perforated diaphragm, and the tube, so as to conduct and deposit the sparks in the box, whilst that portion of the draught which accompanied them and forced them down, is allowed to escape into the chimney, as described."

32. For a *Horizontal Spark Arrester* for Locomotive and other chimneys; Leonard Phleger, Philadelphia, Assignee of W. W. Hubbell, Moyamensing, Philadelphia county, Pennsylvania, June 26.

The patentee says:—"I have combined a horizontal spark arrester and flue with a vertical chimney, which chimney may, in most cases, be made so short as not to require to be turned down, but which may, if desired, be attached to the part constituting the arrester by a hinged joint, and may then be turned down with facility. The horizontal flue that is combined with the spark arrester may be considered as constituting a part thereof, and it is likewise to be considered as forming a part of the chimney; this horizontal flue I sometimes surround by the perforated sheet metal, or wire gauze, by which the sparks are to be arrested."

Claim.—"What I claim, and desire to secure by letters patent, is the combining of a spark arrester, placed in a horizontal position, with a vertical chimney, substantially in the manner set forth, for the purpose of obtaining the necessary length of flue, and of perforated metallic surface for the proper action of the instrument, whilst the vertical chimney itself may be so short as to pass under the lowest bridges upon railroads."

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33. For *Railroad Alarm Signals;* Samuel Nicolson, Boston, Massachusetts, June 26.

There is a curved lever jointed to the track, (the curved surface projecting above the rail,) and connected by bell cranks and wires passing under the track, to an alarm bell elevated to a considerable height, and worked by a weight, in the usual manner. When the wheels of the tender pass over the curved lever, it is pressed down, which communicates with, and starts, the alarm.

Claim.—"I claim as my invention, and desire to secure by letters patent, the method of communicating motion to the alarm, by the passing of the wheels of the tender, &c., over the curved lever connected with the alarm, in the manner specified."

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34. For an improvement in *Casting Composition Screws;* John Luther, Warren, Bristol county, Rhode Island, June 26.

This patent is for making screws with the head and shank of brass, iron, or other hard metal, and for casting thereon a body and threads of soft metal or composition. Into a mould of the form of the intended screw, the soft metal, or composition, is poured, and the hard metal shank, which must be previously tinned, is then inserted, thus causing the soft metal, or alloy, to adhere to the tinned surface of the shank.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making cast screws with iron, brass, or copper heads and shanks, whilst the body and thread are made of tin, lead, zinc, antimony, or any soft metal, or any of these combined."

35. For an improvement in the *Machine for Hulling Rice,* and any other kind of Grain; Webster Herrick, Northampton, Hampshire county, Massachusetts, June 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of two disks, covered with pointed wires, or with stout card teeth, one of which disks is made to revolve vertically within a drum, and is borne up against a stationary disk, similarly armed, by means of a spiral spring pressing against its shaft, and regulated by a tempering screw; and having combined therewith an iron centre plate, or disk, provided with projecting ribs," (for the purpose of throwing the grain towards the wire rubbers,) "in the manner described."

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36. For an improvement in the manner of *Constructing Wheels for Rail and other Roads;* Henry Dircks, Liverpool, England, June 26.

This wheel is formed with a groove, or channel, into which is fitted blocks of wood, with the grain running radially, and bolted to the iron, as a substitute for the iron tread.

Claim.—"I claim the combination of a metallic wheel with a wooden faced tire, or tread, as before described, without being confined to its precise mode of construction, or putting together."

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37. For an improvement in the *Floating Dry Dock,* for raising vessels; John Thomas, New York, June 26.

This improved floating dry dock is of the kind which is made in sections, with floats at each end, for the purpose of assisting the main float in raising the vessel, and to prevent the whole from rocking. Each section consists of a truss frame, on which the vessel rests, and at each end it is provided with a large float, which is made to slide up and down in a frame, by means of screws with double right and left handed threads, which act upon nuts in two sets of followers. There are tongue pieces with key holes along their length, attached to the floats, which pass through mortises in the followers. The turning of the screws causes the followers to approach towards, or to recede from, each other, simultaneously. The advantage of this device is, that as one follower is lifting up, or forcing down, the float, by having the tongue piece keyed to it, the other is returning to the proper place for commencing action when it shall have reached the limit of its play, instead of using but one follower, which requires the operation to be arrested whilst it is returned to its place, or else employing a screw of the whole length of the play of the float.

"I am aware that end floats have been used in floating dry docks for the double purpose of preserving the equilibrium of the dock, and to assist the main floats in the body of the dock, in raising the vessel and frame; the main floats being sunk by admitting water into them, and then by pumping it out, and therefore I do not claim merely the use of end floats, or dispensing with the inner, or main, floats, as made known, and used; but what I do claim as my invention, and desire to secure by letters patent, is the employment of movable end floats of sufficient capacity to raise the vessel, or vessels, and dock, by forcing them down by mechanical force, when used without the the inner, or main, floats employed heretofore, for the purpose, and in manner described. I also claim the combination of the right and left handed screws, followers, tongue pieces, and movable floats, for the purpose, and in the manner, described."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent granted to ARTHUR WALL, *of Shadwell, Great Britain, for a composition for preventing Corrosion in Metals, June 22d,* 1841.

Be it known that I, Arthur Wall, of Shadwell, in the county of Middlesex, in that part of the kingdom of Great Britain called England, surgeon, have invented a new composition for the prevention of corrosion in metals; and I do hereby declare that the following is a full and exact description of it. To enable others skilled in the art to use my invention, I will proceed to describe the mode of manufacturing the same, and the application thereof. I place twenty pounds of the strongest muriatic acid, diluted with three gallons of water, in a shallow pan, or vessel, made of cast iron. I then take 112 pounds of filings of either steel or bar iron, or other wrought iron; I heat them to redness and throw them into the mixture of acid and water, for the purpose of oxidizing the filings. I then place the pan on a sand bath, (heated by a flue from a furnace,) which digests the filings, and facilitates the oxidation. I repeatedly stir up the whole, and after subjecting them to this process for about twenty-four hours, or until ebullition takes place, and the greater part of the filings are taken up by the liquor, or mixture, I allow the oxides thus obtained, to run off through a tap into a vessel beneath, leaving the metal not operated upon at the bottom. When these oxides are quite settled, the clear mixture, or liquor, is run off from them into a third vessel, and then the filings must be subjected to the same process in the original mixture, to complete the oxidation, (that is,) they must be again made red hot, and the mixture which has run into the third vessel thrown upon them, and this process must be repeated until all the filings have oxidized that can be made to do so. The oxides thus obtained I now expose on an iron plate, made red hot over a furnace, until all moisture has evaporated from them, and they assume a red appearance. I then mix with them sixteen pounds of quicksilver, by sifting it through a very fine wire sieve on to the oxides, and afterwards I intimately mix it with them by rubbing the whole down in a mortar, or other suitable process, and when so mixed I then add as much water as will cover the surface, and from eight to nine pounds of strong nitric, or nitrous, acid, and again place the whole on the furnace plate, or iron bath, and repeatedly stir it until all the menstruum, or liquor, has nearly, or completely, evaporated. I then place the whole mass in a mortar, or other pounding machine, and bray, or pound, it until it is in a complete state of blackness. I then mix it with water, and stir, or wash, it until all the light particles are washed out. I then allow it to settle, and when the settlement has taken place, the water is poured off from the sediment at the bottom. This sediment I then place in a crucible, or earthen retort, with a receiver attached, adapted for the reception of any chloride, or mercury, that may escape, or come over, (the contents of this receiver I preserve, in order to re-add to the general mass afterwards, when cool;) then I make it red hot, and when in this state I plunge it into fresh boiling water, and stir it for a few minutes, and then allow it to settle. I then pour the water off, let it cool, and add the chloride, as before stated; and after the last mentioned process, I add to it one-quarter of its own weight of common black lead, or minium, commonly called "red lead," according to the color which the operator wishes the composition to assume. Previously to applying this composition to metal, I add to it such a quantity of boiled linseed oil and spirit of turpentine, (in the proportion of one-fifth of spirit of turpentine to the oil used,) as will reduce it to a state sufficiently liquid to be spread with a brush. This preparation I then apply as thinly as possible, by means of a brush, to sheets of copper, or other metal; which sheets I afterwards subject to a heat gradually raised to about 300 degrees of Fahrenheit's thermometer, so as to make the metal imbibe the preparation; this heat must be applied to the sheets of prepared metal, without smoke or flame, by placing the sheets on trucks in contact with the flue plates, in the manner hereinafter described. The mode of applying this heat may be various, but in order the more distinctly to explain my meaning, and likewise my mode of operating, I shall now proceed to describe the furnace which I use, and find to answer the purpose. I erect two or more horizontal flues, the construction and dimensions of which may be varied according to circumstances, which flues should gradually decline towards the extreme end from the furnace bars, so as to produce a good draught and communicate a stronger heat to the plates above next mentioned. These flues I cover with cast iron plates. I then raise the exterior walls of the furnace to the height of from about three to six feet above the iron plates, which walls must be bound with iron braces to prevent them from cracking, from the excessive heat. I then place thin sheets of iron slightly curved, thus forming a roof, and rest them on the exterior wall. Each end of the chamber (thus formed) is closed by an iron plate, made to slide up and down by a pulley, so as to act as a damper, and let out, or confine, the heat. The heat from the flues is carried away by a common chimney, which has a damper in it for the purpose of controlling the heat. The sheets of metal prepared with the composition as above described, are thus placed upon iron trucks, between upright pins which run on wheels of four inches in diameter, and are thus placed over the iron plates made hot by the flues; the heat must be gradually applied to prevent the composition from blistering on the metal, by the trucks being first placed at the extreme end from the furnace bars, and gradually rolled over the flue till evaporation ceases, and the metal assumes a dark appearance—this completes the operation. When preparing iron tanks with the composition, I apply the furnace heat merely sufficient at first to expel the moisture from the metal, and when in that state I take them out and sprinkle over them as much charcoal, very finely pounded, as will be absorbed by the metal, which gives to the metal, when prepared, a glossy appearance. I then apply the stronger heat, and the operation is completed.

Now, I do not claim as any part of my said invention any of the separate processes, or the use of any vessels or furnaces. But what I do claim as my invention, and desire to secure by letters patent, is the composition prepared as above described, for the prevention of corrosion in metal and for other purposes.

Crane's Anthracite Iron.

Decision of the Court of Common Pleas, affirming the validity of the Patent granted to George Crane, Esq., for Smelting Iron with Anthracite Coal. Delivered at Westminster Hall, June 13th, 1842, by Lord Chief Justice Tindall.

The Lord Chief Justice:—This was an action on the case for the infringement of a patent granted to the plaintiff on the 28th of September, 1836, for an improvement in the manufacture of iron. The declaration was in the usual form, and the defendants pleaded thereto, first, that they were not guilty; secondly, that the plaintiff was not the first and true inventor of the said improvement—upon each of which pleas issue was joined;—thirdly, after setting out at length the plaintiff's specification, the defendants pleaded that the alleged improvement therein described, was not a new manufacture, invented by the plaintiff within the intent and meaning of the statute, as to the public use and exercise thereof in England—which allegation was traversed by the plaintiff in his replication; fourthly, the defendant pleaded that the nature of the plaintiff's invention, and the manner in which it was to be performed, were not particularly described, or ascertained by the plaintiff, in his specification—upon which plea issue was joined; and in their last plea, the defendants, after referring to the plaintiff's specification, before set out in the third plea, stated the grant of letters patent, dated September 11, 1828, to one James Beaumont Neilson, for an improved application of air to produce heat in fires, forges, and furnaces, where bellows and other blowing apparatus were required—that Neilson's invention was the production and application of a hot-air blast, and was in public use with Neilson's license in the smelting and manufacturing of iron from iron-stone, and was the hot-air blast in the plaintiff's specification mentioned—that the plaintiff could not use the hot-air blast mentioned in his specification without Neilson's license, and that he had obtained such license before the grant of his letters patent, and that the using, by the plaintiff, of the hot-air blast, in the smelting of iron from iron-stone, combined with anthracite or stone-coal, as mentioned in his specification, was a using and imitating of Neilson's invention, whereby the plaintiff's invention was void. The plaintiff replied to this last plea, that Neilson's invention was not the same hot-air blast, and that the machinery and apparatus adapted for the application thereof, mentioned and referred to in the plaintiff's specification, was not, nor was the using by the plaintiff of the invention, as described in his specification, a using and imitating of Neilson's invention, described in Neilson's specification; which allegation is traversed by the defendants in their rejoinder. At the trial before me, a verdict was entered for the plaintiff on all the issues, subject to the opinion of the Court, upon the evidence given at the trial, as contained in a report agreed upon between the parties—the Court being at liberty to draw the same inference from it as a jury might draw. On the argument, it was contended by the defendants, that the verdict ought to be entered for them on each of the issues joined on the record; but as the main question between the parties turns on the third issue, which involves the question whether the invention of the plaintiff is a manufacture within the intent and meaning of the statute of James—that is, whether it is or is not the subject matter of a patent—and as the determination of this issue, in favor of one party or the other, will render the decision of the other issues free from difficulty, the simplest way will be to apply ourselves in the first instance to that question. Now, in order to determine whether the improvement described in the patent is, or is not, a manufacture within the statute, we must, in the first place, ascertain precisely what is the invention claimed by the plaintiff, and then, by the application of some principles admitted and acknowledged in the application of the law relating to patents, and by the authority of decided cases, determine the question in dispute between the parties. The plaintiff describes the object of his invention to be the application of anthracite or stone coal, combined with hot-air blast, in the smelting or manufacture of iron from iron-stone, mine, or ore; and states, distinctly and unequivocally, at the end of his specification, that he does not claim the use of a hot-air blast, separately, as of his invention, when uncombined with the application of anthracite or stone-coal; nor does he claim the application of anthracite or stone-coal, when uncombined with the using of hot-air blast; but that what he claims as his invention, is the application of anthracite or stone-coal, and culm, combined with the using of hot-air blast, in the smelting and manufacture of iron from iron-stone, mine, or ore. And the question, therefore, becomes this—whether, admitting the using of the hot-air blast to have been known before in the manufacture of iron with bituminous coal, and the use of anthracite and stone-coal to have been known before in the manufacture of iron with cold-blast; but that the combination of the two together (the hot-blast and the anthracite) were not known to be combined before in the manufacture of iron, whether such combination can be the subject of a patent? We are of opinion that if the result produced by such a combination, is either a new article, or a better article, or a cheaper article to the public than that produced before by the old method, that such combination is an invention, or manufacture, intended by the statute, and may well become the subject of a patent. Such an assumed state of facts falls clearly within the principle exemplified by Abbot, Chief Justice, in the case of the King *v.* Wheeler, 2d Barnewall and Adolphus 349, where he is determining what is, or what is not, the subject of a patent—namely, it may perhaps extend to a new process, to be carried on by known implements, or elements, acting upon known substances, and ultimately producing some other known substance, but producing it in a cheaper or more expeditious manner, or a better or more useful kind. And it falls, also, within the doctrine laid down by Lord Eldon, in Hill *v.* Thompson, in 3d Merivale 629—namely, there may be a valid patent for a known combination of materials previously in use, for the same purpose, or even for a new method of applying such materials; but the specification must clearly express that it is in respect of such new combination or application. There are numerous instances of patents which have been granted, where the invention consisted in no more than in the use of things already known, and acting with them in a manner already known, and producing effects already known; but producing those effects so as to be more economically or beneficially enjoyed by the public. It will be sufficient to refer to a few instances, some of which patents have failed on other grounds, but none on the ground that the invention itself was not the subject of a patent. We may first instance Hall's patent for applying the flame of gas to singe off the superfluous fibres of lace, where a flame of oil had been used before for the same purpose; Derosne's patent, in which the invention consisted in filtering the syrup of sugar through a filter, to act with animal charcoal, and charcoal from bituminous schistus, where charcoal had been used before in the filtering of almost every other liquor, except the syrup of sugar; Hill's patent, in 3d Merivale above referred to, for improvements in the smelting and working of iron; there the invention consisted only in the use and application of the slags, or cinders, thrown off by the operation of smelting, which had been previously considered useless, for the production of good and serviceable metal, by the admixture of mine rubbish. Again, Daniel's patent was taken out for improvements in dressing woolen cloth, where the invention consisted in immersing a roll of cloth, manufactured in the usual manner, in hot water. (See the King *v.* Daniel, in Mr. Godson's book on patents, 274.) The only question, therefore, that ought to be considered on the evidence, is—was the iron produced by the combination of the hot-blast and the anthracite, a better or a cheaper article than was produced from the combination of the hot-blast and the bituminous coal; and was the combination described in the specification new, as to the public use thereof, in England? And upon the first point, upon looking at the evidence in the cause, we think there is no doubt that the result of the combination of the hot-blast with the anthracite, on the yield of the furnaces, was more; the nature, properties, and quality of the iron, better; and the expense of making the iron less, than it was under the former process, by means of the combination of the hot-blast with the bituminous coal. It is to be observed, that no evidence was produced on the part of the defendants, to meet that given by the plaintiff on these grounds, and that it was à necessary consequence, from the proof in the cause, that the substitution of the anthracite coal, in whole, or in part, instead of, or in the place of, bituminous coal, from the substitution of that, the manufacture of the iron should be obtained at less expense. It was objected, in the course of the argument, that the quality, or degree, of invention, was so small, that it could not become the subject-matter of a patent; that à person who could procure a license to use the hot-air blast under Neilson's patent, had a full right to apply that blast to coal of any nature whatever, whether bituminous or stone-coal. But we think, if it were necessary to consider the labor, pains, and expense, incurred by the plaintiff in bringing his discovery to perfection, that there is evidence in this cause that the expense was considerable, and the experiments numerous. But in point of law, the labor of thought, or experiments, and the expenditure of money, are not the essential grounds of consideration on which the question, whether the invention is or is not the subject-matter of a patent, ought to depend; for if the invention be new and useful to the public, it is not material whether it be the result of long experiments and profound research, or whether by some sudden and lucky thought, or mere accidental discovery. The case of Monopolies, 11th Coke, states the law to be, that where a man, by his own charge or industry, or by his own wit or invention, brings a new trade into the realm, or any engine tending to the furtherance of a trade, that never was used before, and that was for the good of the realm, that the King may grant him the monopoly of a patent for a reasonable time. If the combination now under consideration be, as we think it is, a manufacture within the statute of James the First, there was abundant evidence in the cause that it had been the great object and desideratum, before the granting of the patent, to smelt iron-stone, by the means of anthracite coal, and that it had never been done before. There is no evidence on the part of the defendants, to meet that which the plaintiff brought forward. These considerations, therefore, enable us to direct that the verdict ought to be entered for the plaintiff, on the third issue; that it was a new manufacture—new as to the public use and exercise thereof, within England and Wales. On the same ground, also, the second issue is disposed of in favor of the plaintiff. No evidence was produced, on the part of the defendants, to show any inventor earlier than the plaintiff; nor does the fact that there was an earlier inventor appear, from the cross-examination of the plaintiff's witnesses. As to the first issue—namely, whether the defendants had infringed the patent—we think it clearly appears on the evidence, that the defendants had used, either in part or in whole, the combination described in the specification of the plaintiff's patent; the plaintiff's evidence goes fully to show certain infringements, and that is not met by any explanation on the part of the defendants. Indeed, the defendants' case did not appear to rest on this point, at the trial, so much as on the important question raised by them, whether the improvement described in the specification was a manufacture within the statute of James.

Upon the fourth issue, which raised no more than the usual inquiry—whether the nature of the invention was sufficiently described in the specification?—the usual evidence was given, that persons of competent skill and experience could, by following the direction, produce the manufacture described, with success; and this evidence was entirely unopposed. Upon this issue, also, the verdict ought to be entered for the plaintiff. With respect, however, to the issue raised in the rejoinder, in the plaintiff's replication to the fifth plea, we are of opinion, that taking the whole evidence brought forward by the plaintiff, it is impossible to perceive any substantial or real distinction between the hot-air blast, and the machinery and apparatus described in Neilson's specification, from that described, or referred to, in the plaintiff's; or to say that the using by the plaintiff of the invention described in his specification, was any other than a using and imitating of the invention described in Neilson's specification. The plaintiff, indeed, worked by licence under Neilson's patent, at the time of his discovery. On this fifth issue, therefore, we think the verdict should be entered for the defendants. Then arises the question, whether the plaintiff is or is not entitled to the judgment, notwithstanding the verdict on the fifth issue, on which point the argument on the part of the defendants is, that the taking out a patent for an invention, which invention cannot be used or enjoyed by the public, except by means of the former invention of another person, which former invention is itself the subject-matter of a patent still in force, is void by law. Undoubtedly, if the second patent claims, as part of the invention described in it, that which had been the subject-matter of a patent then in force, it would be void, on the double ground that it claimed that which was not new, (which, indeed, would equally be the case if the former patent had expired;) and also that it would be an infringement of, and inconsistent with, a former grant of the King, still in force; which latter consideration, alone, would make a new grant void. But in this case, there is an express disclaimer of any part of the invention to the use of the hot-air blast, which was covered by Neilson's patent, the specification describing that the application of the hot-air blast was well understood, and extensively applied, in many places where ordinary fuel is employed. The validity, therefore, of the plaintiff's patent cannot be impeached on either of the grounds above adverted to. Unless, therefore, the grantee of the new letters patent is bound by law to specify whether such former invention which is excepted, was so excepted on the ground of its being generally known and used by the public, and on the ground that it was the subject of a patent, that secured the use of it to a former patentee, the new patent will be good; but that distinction is as much in the knowledge of the public as the grantee of the patent. If, indeed, the new patent had been taken out for improvement, or alterations, in an invention secured by a former patent, then, for obvious reasons, greater particularity would be necessary to distinguish the new from the old. But the present specification expressly says—"I take the whole of the invention, already well known to the public, and I combine it with something else." Now, it is further argued, that in point of law no patent can be taken out which includes the subject-matter of a patent still remaining, or in force. No authority was cited to support this proposition; and the case which was before Lord Tenderden, and in which he held that where an action was brought for improvements in a former patent granted to another person, and still in force, that the plaintiff must produce the former patent and specification; *that* at least affords a strong inference that the second patent was good. *Lewis* v *Davis,* 3d Carrington, and *Payne* and *Harmer* v. *Payne,* 11th East., are clear authorities on the same point; and upon reason and principle there appears to be no objection. The new patent, after the expiration of the old one, will be free from every objection; and whilst the former exists, the new patent can be legally used by the public, by procuring a license from Neilson, or by purchasing the apparatus from him or some of his agents; and the probability of the refusal of a license, to any one applying for it, is so extremely remote, that it cannot enter into consideration as a ground of legal objection. On the whole, therefore, we think the verdict is to be entered for the plaintiff, on all the issues except the fifth; that the verdict is to be entered for the defendants on the fifth issue—but that, notwithstanding such verdict, the judgment must be given for the plaintiff.

Mr. M. Smith:—My Lord, there are certain certificates which were to be given, in case the judgment was for the plaintiff.

The Lord Chief Justice:—You must apply to me for those; that is not a matter for the Court—that is a matter for myself.

Cambrian.

SPECIFICATIONS OF ENGLISH PATENTS.

Specification of the Patent granted to HENRY BROWNE, *of Codnor Park Iron Works, in the County of Derby, Iron Manufacturer, for Improvements in the Manufacture of Steel. Sealed April* 22, 1841.

To all to whom these presents shall come, &c., &c. My invention relates to a mode of manufacturing steel from iron, by obtaining the iron in a fine granulated state, and then treating it with cementation with carbon, as hereafter described; and in order that my invention may be fully understood, and readily carried into effect, I will proceed to describe the means pursued by me. In working according to my invention, the crude, or pig, or refined metal, is to be treated as if about to be made into bar or malleable iron, by the purifying and decarbonizing process of puddling—that is, by stirring the melted mass in the furnace with iron tools, and exposing it to the action of the heated air, as usually practiced, until the metal becomes in a dry granulated state, all of which is well understood by puddlers; and in place of carrying on the process further in the puddling furnace, the iron, in the granulated state, is to be removed from the furnace, and when cold, a large proportion may be passed through sieves, the meshes of which are about twenty in an inch, and the remainder may be crushed or ground, until the grains will pass through the same sieve, or the various sized grains may be separated by various sieves, differing in the size of the mesh according to the will of the operator; but I consider that the smaller the grains, the more advantageously will the process of manufacturing steel therefrom be carried on; and it is the converting of granulated iron, such as above described, into steel, by cementation with carbon, that constitutes my invention.

The granulated iron is next submitted to cementation, which I perform in the following manner:—I use an ordinary cementing, or converting, furnace, the nature of which is well known, and the cementing chests, or what are usually called pots, are about ten feet long, three feet wide, and three feet deep; but the dimensions may be varied. I prepare a number of frames of iron or wood—I prefer wood, and that which is called pine—an inch or two less in length and breadth, so that they will pass easily into the pots; the frame, made of wood, about a quarter of an inch thick, and one inch deep, and divided by wood partitions, at distances of about every ten or twelve inches. The carbon I prefer to use is wood charcoal, crushed and passed through a sieve, the meshes of which may be about one quarter of an inch square, though other carbon may be used. I place a quantity of the charcoal, to the extent of about half an inch in thickness, over the bottom of the pot; and this I cover with paper, or other suitable substance, on which I place one of the wood frames, and fill the compartments thereof with granulated iron, before described. On the surface of the granulated iron I place another covering of paper, and apply more charcoal, and press it into all the spaces between the frames and the sides of the pot; and I cover the paper evenly to the extent of half an inch; I then apply another thickness of paper, then another frame, which I fill with granulated iron, as before, and cover it with paper; then charcoal, then paper, and then another frame; and so on until the pot is full, having charcoal on the top to the extent of three or four inches deep; I then cover the whole close down with loam sand, or "swarf," from a cutler's grinding-mill, or other suitable substance, to exclude the air, tempered and spread over the top of the pot to the thickness of five or six inches. I now heat the furnace to a high heat, as is well understood by steel manufacturers, and let the pot and its contents remain at that heat for a sufficient time, which I find to be from thirty to sixty hours. The time and heat may be varied, according to the state of carbonization required. The pot and its contents are to remain until cool, and, when opened, the steel will be formed into cakes of the size of the compartments in the frames, and may be removed; the charcoal and paper may be brushed off. The steel thus produced is then broken into pieces, and melted in the usual manner, in crucibles. The high or low state of carbonization may be judged of by the color, which will vary from blue to purple, straw color, and gray; that which is blue having less carbon, and is less firmly united together; and that which is grey, and more united, is charged in a higher degree with carbon. The quantity and hardness of the steel may be varied by a judicious selection of the cemented steel, so as to adapt it to the purposes to which it has to be applied.

Rep. Pat. Inv.

Specification of the Patent granted to JOHN BETHELL, *of Saint John's Hill, Wandsworth, in the county of Surry, for Improvements in Treating and Preparing certain Oils and Fatty Matters. Sealed March* 28, 1840.

To all to whom these presents shall come, &c., &c. The object of my invention, so far as relates to improvements in treating and preparing oils, is to render certain oils, viz: whale, elephant whale, Newfoundland whale, seal, rapeseed, teel, olive, palm, cocoa-nut, or any of the other common oils, more useful, either for lubricating machinery, or for the purpose of illumination, and which I effect, first, by separating, clarifying, or precipitating, a portion of the gelatinous albuminous, or other matters contained therein; and, secondly, (when such are required for burning in lamps, or for illumination,) by adding thereto a portion of hydrocarbon, or essential oils, hereinafter named; and as regards the treating and preparing of certain fatty matters, the object of my invention is the manner in which I have hereinafter described, from butter of palm, cocoa-nut oil, or any other vegetable concrete oil, an oil which is more useful for mixing my purified oils, and which process also improves the fatty matter, or concrete oil, so operated upon, and which improvements I propose to carry into effect, in manner hereinafter described; that is to say—as to that part of the invention which relates to oils:—

First Process.—I take any or either of the common oils above named, and I purify them from the gelatinous albuminous and other matters contained therein, by first thoroughly well mixing the oil with a solution of tannin, which may be obtained from any of the vegetable matters yielding it; but I prefer using a strong infusion of gall-nuts in hot water, of which I take ten gallons, and thoroughly mix it with 100 gallons of oil, in any convenient manner. This mixture must afterwards be allowed to rest for three or four days, until all the tannin infusion, and precipitated matter, has settled down to the bottom. The clear supernatant oil is then drawn off, and again agitated and mixed with a solution of either acetate of lead, acetate of alumine, or sulphate of zinc, which I prefer using in the following proportions—viz: 1 lb. of acetate of lead dissolved in 6 gallons of water, or 1 lb. of acetate of alumine dissolved in 4 gallons of water, or 1 lb. of sulphate of zinc dissolved in 6 gallons of water; and I mix 10 gallons of either of such solutions with 100 gallons of oil; but I do not confine myself to these proportions, as solutions of different strengths can be advantageously used for different oils. The oil, after three or four days' rest, is drawn off from the top, and, if not sufficiently clear, must be filtered through oil-bags, in the usual manner. During the period that the oil is undergoing the above operations, I prefer that it be kept at a temperature as near 17 ° Fahrenheit as possible. Should the oil be afterwards found to contain too much water, I cause it to be agitated with about 10 per cent. of fresh calcined sulphate of lime, in fine powder, or well dried carbonate of soda, to abstract the greater part of the water from it. The sulphate of lime, or soda, must be allowed to precipitate by rest, or the oil must be filtered through bags.

Second Process.—I take the oil as purified by my first process, or I take the more fluid parts of cocoa-nut or palm-oil, and for the purpose of making a good burning lamp-oil, I add thereto from 5 to 10 per cent. of either of the following essential oils, or hydrocarbons—viz: petroleum, or rock-oil, Persian naphtha, fine oil of turpentine, or the best essential oil, obtained from the distillation of coal-tar, or the oil obtained, as hereinafter described, by distilling any of the above essential oils with palm or cocoa-nut oil; the quantity to be added depends on the kind of oil operated upon, and upon its strength, and will vary between 5 and 10 per cent., but will be easily ascertained by trying a small sample of the oil first. The essential oil, or hydrocarbon, must be intimately combined with the oil, either by thorough agitation together, or by passing the vapor of the essential oil, or hydrocarbon, into the oil in an apparatus similar to a Wolfe's apparatus, but the former method I prefer for general use. In some cases, either from the oils operated upon being of a superior quality, or from so fine an article not being required, it is not necessary to use both the above processes, as either of them will be found sufficient for the purpose required. If a superior burning lamp-oil is required, I prefer using both of the above processes; but for a common lamp-oil, the oil may be prepared by either one of the above processes, without being submitted to the other, particularly when it is prepared by the second process only; and for a lubricating oil the first process only is used. As to the treating and preparing fatty matters, I take the "butter of palm," or "rough palm-oil," or rough "cocoa-nut oil," or any other concrete vegetable oil, and add to either of these, 20 per cent. of either of the essential oils above named. Put it into a common still, and distill off the essential oil, and the volatile matter which rises from the palm, or cocoa-nut, oil; but I prefer distilling with steam, and for that purpose I put the mixture into a close wood-vat, furnished with a steam pipe, leading from a steam boiler, and branching out into several other pipes, placed in the bottom of the vat, and pierced with small holes; the charging-hole of the vat being shut, steam is driven through the mass, and the volatile products are conducted, through a pipe fixed in the top of the vat, to a common distilling-worm, placed in cold water. The volatile oil so condensed, I mix with the oils for burning in lamps, as above mentioned, and the concrete fatty matter remaining in the vat is run out into casks, and will be found much improved, and more useful for many purposes.

In describing my improvements, I have stated the proportions of the different materials to be used, which I prefer; but I do not confine myself to such proportions, as they may be advantageously varied from different oils.

Ibid.

Specification of a Patent granted to Alexander Parkes, *of Birmingham, Artist, for certain Improvements in the production of Works of Art, by Electric Deposition. September* 29, 1841.

These improvements consist in manufacturing articles in gold or silver by means of electric deposition upon suitable moulds, and in subsequently strengthening the articles so produced.

For this purpose, the patentee uses the following solutions of these metals:

Gold. An ounce of pure gold is dissolved in aqua regia, and evaporated to dryness, when 2 gallons of water, and 16 ounces of prussiate of potash, are added to it. This solution is used at a temperature of 120°, or 130°, of Fahr.

Silver. An ounce of pure silver, dissolved in nitric acid, is precipitated as oxide of silver, by lime water; the oxide being well washed, is mixed with 1 pound of prussiate of potash in 2 gallons of water.

The moulds used for this purpose are of metal, or other suitable material, in one or more parts, and may be removed from the finished article by melting or dissolving them.

The patentee prefers to use the compound, or independent, battery, from which the electric current is conveyed from the battery into a cell, or vessel, containing the metallic solution, and a plate of gold or silver, to be eroded by the electric action.

If the metal is to be precipitated on the interior of a mould, as in forming a bust, &c., the plate is placed within the mould; but if the metal is to be deposited on the external surface of the mould, the plate is placed on the outside thereof.

If the article produced requires greater strength than would be desirable to be given by the thickness of the precious metals, it may be strengthened by depositing copper within it, until the required substance is obtained; or the article may be filled with some fusible metal.

The claim is 1. To the mode of manufacturing articles in gold and silver, by depositions thereof, by electric agency, in or on suitable moulds or models, which may be removed from the articles of gold or silver, when the same have been formed. 2. To the mode of manufacturing articles of gold or silver, on or in metal moulds or models, which are deposited by electric means; such moulds, or models, being afterwards removed, as described. 3. To the mode of manufacturing articles of gold or silver, by electric deposition, on or in moulds or models, when such moulds or models are removed by heat or solution. 4. To the mode of manufacturing articles of gold or silver, by electric deposition, in or on moulds or models made up of parts. 5. To the mode of strengthening articles of gold or silver, produced in or on moulds, by electric depositions, by introducing a baser metal within them.

Mech. Mag.

METEOROLOGICAL OBSERVATIONS FOR APRIL, 1842.

Moon.	Days.	Therm.		Baromtr.		Wind.		Water Fallen in rain	State of the Weather, and Remarks.	
		Sun Rise.	2 P.M.	Sun Rise.	2 P.M.	Direction.	Force.			
	1	28°	43°	30.20	30.30	NW.	Moderate		Clear.	Clear.
☽	2	40	66	30.20	30.14	SW.	Brisk		Par. Cloudy.	Clear.
	3	54	70	29.94	29.94	SW.	Moderate		Cloudy.	Lightly cloudy.
	4	45	50	29.94	30.00	E.	Brisk	.55	Drizzle.	Rain.
	5	40	47	29.95	29.95	E. W.	Moderate		Cloudy.	Cloudy.
	6	44	64	30.00	30.15	W. SW.	do		Clear.	Hazy.
	7	50	52	29.85	29.85	SE.	do	.25	Fog.	Rain.
	8	46	48	29.55	29.66	NE. E.	do		Cloudy.	Cloudy.
	9	44	42	29.70	29.73	NE.	do	1.20	Rain.	Cloudy.
⊗	10	40	60	29.90	29.90	W.	do		Clear.	Clear.
	11	50	68	29.80	29.84	W.	Brisk		Clear.	Clear.
	12	50	66	29.85	29.85	E NW.	Moderate	.24	Clear.	Rain.
	13	44	46	29.90	29.93	E.	do		Cloudy.	Drizzle.
	14	40	56	29.75	29.80	NW.	do	.50	Rain.	Clear.
	15	42	64	29.90	29.95	W.	Brisk		Par. cloudy.	Flying clouds.
	16	43	59	30.05	30.10	W.	Moderate		Par. cloudy.	Partially cloudy.
	17	45	44	30.14	30.14	E.	Blust'ring		Rain---hail.	Rain.
☾	18	41	44	29.91	29.90	NE.	Brisk		Rain.	Cloudy.
	19	41	46	29.68	29.60	NE.	Moderate		Cloudy.	Cloudy.
	20	46	61	29.60	29.65	W.	do		Par. Cloudy.	Partially cloudy.
	21	46	64	29.95	30.06	E. SE.	do		Clear.	Clear.
	22	46	74	29.96	29.85	SW.	do		Clear.	Clear.
	23	62	73	29.70	29.85	W.	do		Clear.	Clear.
☺	24	59	73	30.00	30.00	SE. S.	do		Cloudy.	Lightly cloudy.
	25	55	75	29.85	29.85	S. W.	do		Fog.	Clear.
	26	61	81	29.64	29.50	SW.	Brisk	.35	Clear.	Showery.
	27	49	60	29.45	29.45	W.	do		Clear.	Flying clouds.
	28	44	50	29.60	29.65	W.	do		Par. cloudy.	Partially cloudy.
	29	40	64	29 85	29.80	W.	do		Clear.	Clear.
	30	40	66	29.80	29.80	SE. SW.	Moderate		Clear.	Lightly cloudy.
		45.83	59.20	29.85	29.87			3.09		

Trermometer.
Maximum 81.00 on 26th.
Minimum 28.00 on 1st.
Mean, 52.515

Barometer.
Max. 30.30 on 1st.
Min. 29.45 on 27th.
Mean 29.86

MAY, 1842.

Moon.	Days.	Therm.		Baromtr.		Wind.		Water Fallen in rain	State of the Weather, and Remarks.	
		Sun Rise.	2 P.M.	Sun Rise.	2 P.M.	Direction.	Force.			
	1	48°	73°	29.67	29.50	W.	Brisk		Fog.	Clear.
☽	2	48	50	29.50	29.50	NW.	Moderate	.30	Cloudy.	Showery.
	3	45	47	29.70	29.75	NW. SE.	do	.56	Cloudy.	Rain.
	4	45	56	29.75	29.75	W. NW.	do	.06	Cloudy.	Shower.
	5	42	65	30.10	30.10	NW.	Calm		Clear.	Clear.
	6	45	72	30.06	29.90	SW.	Brisk		Clear.	Clear.
	7	50	64	29.90	30.14	W.	Moderate		Clear.	Clear.
	8	41	67	29.95	29.80	W.	Brisk		Foggy.	Lightly cloudy.
	9	43	49	29.70	29.70	NW.	do		Clear.	Flying clouds.
⊗	10	46	71	29.80	29.70	W.	do		Cloudy.	Cloudy.
	11	56	81	29.66	29.60	SW.	do		Par. cloudy.	Clear.
	12	52	65	29.75	29.80	W.	do		Clear.	Clear.
	13	47	75	29.85	29.70	SW. S.	Moderate		Clear.	Lightly cloudy.
	14	45	64	29.90	30.00	NW.	do		Clear.	Clear.
	15	43	62	29.90	29.85	W. SE.	do		Clear.	Cloudy.
	16	42	72	29.85	29.86	W. SW.	do		Clear.	Clear.
☾	17	56	79	30.00	30.03	W.	do		Clear.	Hazy.
	18	56	75	30.10	30.10	SW.	do		Cloudy.	Cloudy.
	19	56	76	30.00	29.94	SW	Brisk		Cloudy.	Clear.
	20	47	42	30.05	30.20	SE. NE.	do	1.65	Rain.	Rain.
	21	41	63	30.20	30.15	E.	Moderate		Cloudy.	Lightly cloudy.
	22	50	60	29.95	29.30	SW.	do	.10	Cloudy.	Cloudy---rain.
	23	58	69	29.70	29.74	W.	do		Cloudy.	Flying clouds.
☺	24	56	66	29.90	29.90	SE.	do	.20	Fog.	Rain.
	25	55	69	29.80	29.83	NW. W.	do		Cloudy.	Flying clouds.
	26	53	73	29.85	29.90	SW.	do	.65	Clear.	Lig't cl'dy---rain.
	27	56	67	29.84	29.75	E.	do	.10	Rain.	Cloudy.
	28	57	74	29.80	29.80	W.	do		Clear.	Clear.
	29	57	76	29.80	29.65	W.	do		Par. cloudy.	Par. cloudy.
	30	64	71	29.56	29.56	W.	do	.45	Showery.	Showery.
	31	54	69	29.65	29.74	W.	do		Clear.	Clear.
		50.13	66.58	29.85	29.81			4.07		

Thermometer.
Maximum 81 on 11th.
Minimum 41 on 8th and 21st.
Mean 58.355

Barometer.
Max. 30.20 on 20th & 21st.
Min. 29.30 on 22nd.
Mean 29.83

JOURNAL

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SEPTEMBER, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cost of Transportation on Railroads. *By* C. Ellet, Jr., *C. E.*

I have never yet seen any formula, derived from the experience of active lines, by which the cost of transportation on railroads may be determined with an approach to accuracy. The expenses of maintaining a line of railroad are not *all* proportional to the distance traveled by the locomotive engine, nor to the tonnage conveyed; neither are they all independent of either of these considerations. But the aggregate annual cost is made up of certain items, which are, in fact, nearly proportional to the distance run by all the engines; of others which are strictly proportional to the tonnage conveyed; and of some which are nearly, or quite, independent, both of the trade and of the distance traveled.

I offer the following rule for the determination of this aggregate, in the belief that every well managed railroad, of ordinary construction, carrying engines of ordinary power, where the transportation is effected at the usual speed, and which accommodates a respectable amount of business, will exhibit results in close agreement with its indications. This formula is derived from the considerations which follow, and the constant quantities are supplied from the best experience I have been able to obtain from the past management of the public works of this country. In course of time, when the velocity of burthen trains is reduced to three or four miles per hour, and companies learn to know where and how to economize, it is probable that some of the items may be reduced; but time and experience have yet to decide how much.

I. *Repairs of Road.*—The repairs of a railroad consist of two distinct divisions; the first of which is nearly independent of the amount of the trade, and may be estimated, on the average, at about $500 per mile. The second division is dependent on the amount of the tonnage, and represents the injury done to the road by the passage of one ton of freight. I estimate this wear and tear at $\frac{35}{100}$ of a cent per ton per mile.

II. *Expense of Cars.*—The expense of repairing and renewing the burthen cars is proportional to the distance which they run, or to the tonnage of the line; and may be estimated at $\frac{45}{100}$ of a cent per ton per mile.

III. *The expense of agents, conductors, the force at depots, breakmen, and contingencies of all sorts,* is likewise nearly proportional to the business of the road, and cannot be assumed at less than *six mills* per ton per mile.

IV. *Locomotive Power.*—The expense of repairs and renewals of locomotive engines and tenders, the cost of fuel, and the pay of enginemen and firemen, are nearly proportional to the distance run, and may be estimated at *thirty cents* per mile traveled by the engine.

Now, to express the cost of maintaining a line of road, under good management, for one year, let us represent by

N the number of miles run by all the engines;
T the whole number of tons net conveyed one mile; and
h the length of the road in miles.

Then, according to the foregoing data,

$$\frac{3\,N}{10} + \frac{14}{1000}\,T + 500\,h.$$

will be the aggregate annual cost in dollars, (where the business consists exclusively of tonnage,) of maintaining the line and its equipage.

If the road accommodates a mixed business, of trade and passengers, to obtain the aggregate expense, we must add $\frac{1}{100}$ P—where P represents the whole number of passengers carried one mile.

This formula takes proper account of the difference of grades, but is not applicable to very short roads—to roads doing a very inadequate business—by which I mean less business than can be accommodated by one engine—nor to the first four years' operations, while the road, cars, and locomotives, are yet all new.

By applying this rule to the active lines of the country, it will be found that the larger establishments—those which possess a valuable trade—give very similar results.

There are none on which the expenses fall within the limit assigned by the formula, excepting, perhaps, one or two which have been recently completed, and on which the cost of renewing the iron, timber, bridges, cars, and locomotives, is not yet very sensibly felt. It will be found to suit those cases better a few years hence.

[To be continued.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reply to the Notice of the "Projected Water Works at Albany, New York," published in the Journal of the Franklin Institute, vol. iii, 3rd series, page 380.

The following remarks are submitted in reply to strictures upon my Report on the Albany Aqueducts. Without intending anything disrespectful to the courteously expressed opinions of the writer, I may be allowed to say I am rather pleased the plan should have met with opposition—as this, I believe, has invariably been the fate of every new plan, of much importance, which has at any time been brought forward. I have only to regret that such extracts did not accompany the review as would have placed at least the main features of the plan before the reader in a perfectly *intelligible* shape; had this been done, present remarks would have been less necessary, as I trust to show, in a brief space, that the opinions advanced are *imaginary*, and rather the result of *misconstruction* of the nature of the *plans proposed*, or of *misconception* of *what really are the results of practice* on the part of the writer, and the practical friends consulted, than of any over-adherence on my part to "the theory of the question."

I. He cites a trial at Fairmount as a "stubborn fact," proving incontestibly that, *in practice*, water cannot be made to rise, in a jet, over three-eighths of the height of the fountain, or reservoir, and of course that the plan I proposed of making the head of water available for the extinguishment of fires, and which anticipated a jet rising much nearer the level of the reservoirs, must be wholly inefficient.

Now the *essential circumstance* of the trial having been made with a single adjutage of one inch diameter, has been entirely overlooked; while it is a "stubborn fact" that with a plentiful supply of water, and given height of fountain, *the height of the jet may be increased* through a very great range, simply by varying the size of the orifice of the adjutage. My plan had due reference to this appropriate orifice for the jet, and the writer's opposition to it arises from want of knowledge of any such requirement; in other words, from mistaking an *individual fact* for a *principle*, and resting his opinion entirely upon the *imaginary* strength of a trial, which could decide *nothing* except the naked fact that, with exactly the same plan and arrangements, a jet of but thirty feet only can be produced. There can be no hazard in expressing the opinion that the head of water at Fairmount is capable of forcing up a jet of at least double this elevation.

Not to expatiate further on this, I will but mention some recent trials, which confirm, decisively, all the views put forth in my Report to the Common Council of this city. It is but a few days since jets of one hundred and fifteen feet were produced at the Haarlæm River, on the Croton Aqueduct; which proves that after allowing for the difference in the elevation of the fountains, all my anticipations will be *at least fully realized.* For the matter of that, the elevation of our fountain being two hundred and sixty feet above tide level in the Hudson, (nearly twice that at Haarlæm, and more than three times that at Fairmount,) I had all along anticipated much greater things than has recently been done at Haarlæm, in the lower part of the city, which contains the bulk of population, where I had no doubt we should be able to cast a jet over the spires of the churches.

II. The writer does not comprehend my plan. Every part of the conduit, except the brief length of the depurating sections, is graded, and descends from the reservoirs, and lies within fifty-five feet of the level of the fountains. Ventilators cannot, in any event, be requisite at more than two points, and can be effected at so small an expense, as not to be worth mentioning—any expense of this description being fully covered by, and provided for, in the allowance for contingencies in the estimates of cost.

III. The writer has again misconceived my plan. The *depurating sections* were subordinate appendages, established only where my plan of *grading the profile* required the level of the conduit to be *sunk;* and the only addition of expense on these sections was for "*roil-chambers,*" which were intended "to obviate all risk *from* deposition of sediment in the duct, and of interruption to the regularity of the supplies, &c.; to give absolute control over whatever of sediment the water might contain after being introduced within the conduit, and to provide for its removal from the conduit before reaching the city, at given periods," &c. Does the writer in the Franklin Journal hazard the opinion that in case of such deposites (which he admits do take place in the Philadelphia conduits, and of which I gave an instance in my Report, on a small, but still practical, scale,) the simple force of a current of one mile and a quarter per hour in the conduit, would be sufficient to *force* the sediment up the banks of a gulf rising eighty feet, at an angle slightly less than forty-five degrees; or that simple cocks, without any enlargement of the section of the conduit, would not require *frequent attendance at each, and* *be both troublesome and expensive to manœuvre;* or that an enlargement must of necessity *sensibly* check the flow of the water? The roil-chambers do not demand constant attendance, and their cost could *not exceed the expense of cocks*, properly guarded from freezing up, as they must be to be of any practical value.

The mode of venting this, besides, gives at all times perfect command over the whole of the water in the conduit, and there are various ways in which this quality alone may promote the efficiency of the aqueduct.

IV. With regard to the thickness of the conduit, I have to remind the writer that he does not show that the *practice* in Philadelphia is founded upon any exact knowledge of their capacity to sustain a determinate pressure, or head, of fluid, with a given size of pipe. He is, doubtless, aware that the authority of *practice* is little more than the authority of *conjecture, where not so founded.* He admits, besides, that the pipes are actually tested at a pressure more than five times greater than the head they actually had to work under; that "they rarely fail, and that it may be said with truth, these failures usually occur at imperfections."

This is candid. Will the writer be good enough to define what degree of excess of thickness will always make pipes secure, on the supposition that they fail only at imperfections? If a part of the Water Works at Philadelphia had been laid with pipes of two-thirds of an inch thick, a part with pipes of half an inch, another with pipes of one-third of an inch, &c., something determinate, it is conceded, might have been concluded from the practice there. Had this been done, it would have been found that the least thickness would have stood equally well with the greatest; and that failures only occurred where imperfections existed at the time of laying them down; and *the practice would now be* to lay only the thin pipes—that is, it would have been so had further provision been made against corrosion of the pipes by rust, agreeably to the plans proposed in my Report.

I am not positive, but believe that the pipes of the conduit at Haarlæm, now on the Croton Aqueduct, are the three feet pipes which are ultimately to surmount the high aqueduct bridge over that river. They are now *actually working* under a head a great many times greater than can ever come upon them when occupying the position they are intended for. The actual head has been stated at one hundred and forty feet; consequently, if not mistaken in the size of the pipes, they are now actually working with *considerably less* than the equivalent of a quarter of an inch for a seventeen inch conduit, under a head of fifty-five feet. This is decisive as to the thickness *actually* required in practice.

The enormous surplus put into the Philadelphia pipes, merely to guard against an occasional imperfection, (which experience proves it fails to do,) seems to be but little more consistent than to add to that still more in order to render it impossible, in case of invasion of the good city of Philadelphia, for the enemy to uncover and fracture the conduit, by sledging.

The candor of the writer will now concede, I think, that the practice at Philadelphia does in nowise negative the dimensions assigned in my Report on the Albany aqueducts, and that other works, on a still grander scale, *fully confirm* their efficacy at least; and, consequently, that *actual practical cases* afford sufficient evidence that my estimates of the cost of erecting the conduit, are at all events *not too low.*

V. With regard to the length of the links of conduit, I have nothing to reply, but to state that when skilful founders shall, under the inspection of the writer and myself, make an attempt, with additional sprues, &c., another expedient a little out of the usual routine, (as was suggested by Mr. J. Rogers, one of our most skilful machinists, and himself an experienced founder, as the means of meeting the difficulty of casting thin pipes,) and shall fail in ability to produce links of fifteen feet, I will cheerfully surrender my conviction, on this head, to the writer, and use lengths of ten feet.

VI. It is certainly true, in theory, that the protecting metal in a galvanic circuit is in itself liable to corrosion; but is not the writer in the Franklin Journal aware that this is not always necessarily so *in practice?* and, with regard to zinc, particularly, we have the authority of Sir Humphrey Davy (who determined the question in the most explicit manner, with express reference to an equally important and practical subject,) that after the first coating of oxide has formed, that that coating effectually protects the zinc from further detriment, while the iron remains perfectly under the influence of the galvanic action excited.

But the writer has, besides, misapprehended my object entirely. I did not propose zinc as a better material than lead for simply *closing and securing the joints*—nor yet because it was cheaper. Perhaps no metal whatever can afford a more perfect joint than lead, as regards both "tightness and durability." My object was much more important than either of these. I proposed to employ it *solely on account of its protecting quality*, with the view of dispensing with the enormous quantity of material usually put in the body of pipes, considering that if the oxidation of the metal were arrested, surplus beyond a certain thickness could serve no useful purpose.

The writer is too liberal, I think, to object because I kill, as it were, two birds with one stone—the plan proposing to arrest the corrosion by the same operation which closed and secured the joints.

As regards the great expense of sealing with zinc, the writer forgets that a given volume of zinc does not weigh more than two-thirds as much as the same volume of lead, and, consequently, that ninety-four and a quarter pounds of lead are required for sealing the same joint that sixty pounds of zinc would secure. The prices of the two metals being nearly inversely as the weights of metal required, leaves the expense of sealing a joint about the same, which ever metal is used. But even if this were not so, the object with which the metal is employed is a paramount consideration.

VII. As regards the velocity of the pistons of the elevating machinery, I beg leave, with due deference, to say, I cannot perceive any force in the writer's theory as to "the momentum not being kept up whilst the piston clears the dead points, &c." The writer, in the fervor of his affection for the Philadelphia works, seems to think these works a model of perfection, which can in no respect be departed from without "practical error." Beautiful and useful as are the celebrated works of Fairmount, I must be permitted to say that the writer entertains very erroneous and unsubstantial views when regarding them as paragons of perfect skill. That the whole works of that city might have been made vastly more useful and efficient, at an expense very much less than they have cost for construction, I cannot but think must be apparent to every person capable of understanding and appreciating the discussion which the writer's critique has produced.

That there are other *very* important points of difference between the projected Albany works and those at Fairmount, is a truth of which I was aware at the time of proposing my plans last autumn; but these, like the rest, were designedly so, though in nothing which is not justified by the errors of practice.

WM. MCCLELLAND CUSHMAN, C. E.

Albany, New York, July 22nd, 1842.

Facts and Observations on Four and Six Wheel Engines.

By JOHN HERAPATH, ESQ.

[CONTINUED FROM PAGE 79.]

North Midland Railway.

We believe that this line was originally projected by Mr. Henry Patteson, the late Secretary, and Mr. George Stephenson, the Engineer. It unites Derby with Leeds, and forms part of the main trunk line to the north of England, on the east side of the island. Its length is 72¾ miles, and it joins on the south at Derby and Midland counties, and the Birmingham and Derby Junction Railways; and on the north, the Manchester and Leeds, Leeds and Selby, and York and North Midland.

One of the most troublesome works upon this railway was the Clay Cross Tunnel. In fact, it was almost another Kilsby affair; and even now is a constant source of annoyance from its gradient and the wet, which oblige the engines passing one way through, that is from Leeds towards Derby, to be always using the sand-hoppers to give bite to the wheels.

On this line I observed a peculiarity in the mile posts which I do not remember to have seen on any other line, and with which I was much pleased—that is, the mile posts have large round heads, by which they are immediately known, even in the night; and the ¼, ½, and ¾ mile, were simply straight posts. The mile posts have marked upon them the gradient of the place, with a line between the figures, inclined to the horizon in such a way as to show which direction the ascent or descent takes. Simple as this contrivance appears to be, it is very useful to travelers, and it might be advantageously introduced upon all railways. We believe it was designed by Mr. Robert Stephenson, the engineer of the line.

A remarkable feature on this line is the stations; perhaps the neatest that I have seen upon any other line of railway. The average cost of them, I understand, is about £3,000 each. But of all railway stations, that at Derby claims most the traveler's attention. It was stated to me that it stands upon about 33 acres of ground, and cost nearly a quarter of a million of money. The extreme length of the shed is 1,050 feet; and breadth, 140 feet. It appeared, I thought, to be inconveniently long; but I was informed that it was often filled from end to end with carriages. The business of all the three Companies is here carried on by the North Midland Company. I had no opportunity of going much over the offices, but from what I saw of them, I thought them pretty well laid out. Their only fault appeared to be that they were rather too capacious, which is, perhaps, erring on the right side. I went over the store department, under the management of Mr. Finlayson, and was exceedingly pleased with the order, regularity, and systematic manner in which the stores were kept. Every item had its separate and appropriate place; and there was not a nook in his offices which was not advantageously occupied.

Their workshops are upon the plan of the Wolverton establishment, as might have been expected from Mr. Glyn having presided over both Companies; but they have not yet arrived at that maturity in their machinery, &c., which the London and Birmingham Company have.

Here I had an opportunity, through the politeness of Mr. Finlayson, of seeing Mr. Edmonson's plan for printing and numbering railway tickets. Some idea may be formed of the utility of this invention, from the fact that it printed and numbered consecutively from 4 to 49 in one quarter of a minute, or above three in one second—the man not working the machine over fast. It is, certainly, a very simple and useful invention.

The Midland counties locomotive establishment here is not on so extensive a scale, but, from the cursory view that I took of it, it appeared to be more matured. I had no opportunity of going over the Derby Junction locomotive establishment, as I was suddenly called to town.

Monday, Nov. 6, I came in upon this railway at Leeds, on my return from the north.

Their engines are all distinguished by numbers, as on the London and Birmingham Railway. I got upon No. 7 engine—6 feet driving wheels, eighteen inch stroke, 14 inch clylinder. She certainly was not one of the most steady engines that I have been upon, nor one that I should at all call steady. The next day I took a trip with Mr. Marshall, the superintendent of the North Midland locomotives, from Derby to Masborough, and returned on No. 19, an engine by Robert Stephenson. This was a much superior engine to the last, in point of steadiness and ease of motion. She had none of that pitching and working against herself, nor any of that wriggling motion of the former. I understand that she was one of Stephenson's latest engines.

As the engines on this line are all six wheeled, and of nearly the same pattern, I did not think it necessary, particularly as my attendance in town was required, to go upon more than the two I had tried.

Their stock of engines consists of 30 passenger engines, uncoupled; and 10 good engines, coupled. They are all six wheel engines, with outside bearings. Seventeen engines have six feet driving wheels, and four feet leading and trailing wheels, with 14 inch cylinders and 18 inch stroke. Their weight is 18 tons in a working trim—that is, 8 tons on the driving wheels, 6 on the leading, and 4 on the trailing wheels. Three engines are exactly similar to the above, except having wheels 6 inches smaller in diameter. Ten engines have 5 feet driving and leading wheels coupled together, with 3½ feet trailing wheels. In other respects they are similar to the former. Ten engines have 5½ feet driving wheels, and 3½ feet leading and trailing, with 13 inch cylinders, and 18 inch stroke. The weight is 15 tons, distributed in proportion to those of the 17 engines above mentioned.

Of these 40 engines, 30 are in a fit state to take a train. The driving wheels have no flanches, and the coupled engines are said to work very satisfactorily.

The gross average load of the passenger trains, including engine, tender, and empty carriages, is 60 tons; and 150 tons the goods trains.

There have been about 30 detentions of trains from partial derangement of the engines, one third of the causes of which occurred in the boiler and wheels, another third in the cylinders, and the last third in the valves and pipes. In one year and a half there have been three broken crank axles while running, and three others were replaced before they were broken through. Those running were unable to proceed with their trains, but stopped in a short distance, without getting off the rails, or any accident to the passengers. Mr. Marshall said the axles broke from the imperfect welding of the iron, or flaw in the crank. These accidents all happened with uncoupled engines, two on a straight line, and one on a curve. There have been no engines run off the line. The axles which broke were 5½ inches diameter; the driving wheels 6 feet, 14 inch cylinder, and 18 inch stroke, with a steam pressure of 60 lbs. in the boiler, which appears to be the average pressure of their engines.

The average cost of the engines is £1,600; the consumption of coke, 33 lbs. per mile for the passenger engines, and 50 for the goods engines, or 40 for the average, and 46 per mile consumption of the regular trains, including pilot and assistant engines. The general character of the engines is stated to be steady in their motions. They are 18 feet long, and 11½ feet distance between the extreme axles. They have no proof that the distance of the cranks from the middle of the axles produces any sinuous motion.

The total number of miles run per annum is 600,000, or 15,000 per engine per annum, at an expense of 3¾d. per mile each engine. I suspect this is for the repairs only. The age of their engines is all one year and a half.

Each engine takes two trips per day, of 73 miles, or 146 miles daily; and their average time of work is three days out of four.

Great North of England Railway.

All the passenger engines of this Company, except two built by Robert Stephenson, are made to a pattern engine furnished by Hawthorn & Co. They have 12 inch cylinder, 18 inch stroke, and 5½ feet driving wheels. The distance between the leading and trailing wheels is 10½ feet; between the centres of the cylinders, 1 foot 11 inches, which accounts for the rather unusual height of the boiler, which I noticed above the framing. They run from one end of the line to the other, and back, daily—90 miles—and stay in one day out of four, for repairs, &c.

The merchandize engines are also built to a pattern furnished by Hawthorn & Co. The front and driving wheels are 4½ feet diameter, and coupled. They are principally used in taking coals to the depôts along the line, and consequently have no regular daily distance to run, but remain one day in five in the shed, to clean and repair. They draw from 26 to 36 coal wagons, each weighing, when loaded, 5¼ tons; and, of course, have the wagons to bring back empty.

Their stock of locomotives consists of 12 passenger, and 20 merchandize engines—including two ballast engines, used in forming the line, which are at present out of repair. They are all six wheel engines, and all have outside bearings, except two passenger engines, which have additional inside bearings on the crank axle. Their engines have not been weighed. The gross average load of the passenger trains is 50 tons, and of the merchandize 130. Twenty of these engines have four wheels, coupled, which are found to work steadily and safely; but they are only used at slow speeds. All the engines but three have flanches on the driving wheels. With the exception of four, and the two ballast engines mentioned above, they are all in a fit state to take a load. Twice only have the trains been detained from the failure of machinery—in one case from a broken piston, in the other from a burst tube. They have had no broken crank axles, nor any instance of engines having run off the rails, except from neglect of points or switches, or through collisions. The average cost of their engines is from £1,500 to £1,700 including tender. Average consumption of coke from 36 to 38 lbs. per mile. The engines are described to have scarcely any motions, except what may be attributed to imperfections of the road; nor have they any top-heavy engines. The total daily run of the passenger engines is 450 miles, and of the merchandize, 320—exclusive of ballast engines. The steam pressure is from 50 to 55 lbs. per square inch. At present the expense of repairs cannot be ascertained, on account of the line having been opened so recently.

London and South Western Railway.

The delay in giving my account of this railway has arisen from having learned that they have four as well as six wheel engines, which I was very desirous to try together on the same line. This line, which was originally laid out under the name of the London and Southampton Railway, was evidently designed to become the grand trunk line to the west of England, and altogether to supersede the necessity of the Great Western Railway. From the detour which it makes just below Basingstoke, it was obviously meant to be extended westward, so as to take in Salisbury, and all the western parts of England, and to make the line to Bristol a branch of it. The imbecility, however, of its former management, and the extravagant expenditure of the Great Western, defeated their object, and confined them literally to the title of their line, a London and Southampton railway.

On Nov. 13th I had an opportunity of riding on three of the Company's engines. I went down to Winchester on the *Queen* engine, a six wheel, with 5½ feet driving wheels, 18 inch stroke, and 13 inch cylinder. Her weight was stated to be 14 tons 14 cwt., and the tender half the weight. Its total length was 15 feet, and the length from the hind axle to the driving axle was 5 feet 2½ inches. The hind axle to the front was 10½ feet. The coupling with the tender was rather below the driving axle. She had outside bearings, and flanches below the driving wheels. Her working time is said to be about 9 months out of 12. She consumes 17 cwt. of coke every journey of 76½ miles, and the driver said about 1,400 gallons of water. The play of her wheels upon the rails was one inch. She is considered to be a very good and steady engine. All the through engines run a journey each way daily, generally without drawing the fire. In one case I was told this engine ran about 306 miles without having the fire taken out. Each engine takes the mail train a week round. The driver of this engine, who appeared to be a steady and attentive man, and had been upon the London and Birmingham line, considers outside bearings to be more unsteady than inside. He thinks on bad roads six wheel engines are steadier than four, but admits that the London and Birmingham four wheel engines work very well. This engine appeared to me to have a sinuous motion of about two inches, and no pitching or rolling motion. Her front springs were in a constant play, and she was easy to ride on. On curves, and drawing up hill, she appeared to be rather steadier; but in descents, at high velocities, her sinuous motion was very marked.

At Winchester I dismounted, and waited until another engine, the *Eclipse*, came up, on which I went to Southampton. This was a six wheel engine, with outside bearings, and a 13 inch cylinder; but I could not get the length of the stroke. From the hind to the driving axle she was 5 feet 1 inch, and to the front axle 10½ feet—the same as the *Queen*. Her total length was 15½ feet; she had a play of 1.2 inch on the rails. The whole of the way I rode with this engine was down hill, and at a high velocity. After making her what I thought a fair allowance for these circumstances, she appeared to me to be more unsteady than the *Queen*, and had much more sinuous motion. Her apparent sinuous motion was full three or four inches. The coupling appeared to be one foot above the driving axle, and she was pulling upwards. Probably the play of the axles on the bearings was partly the cause of her greater unsteadiness.

I left Southampton at six, by the *Orion*. It being dark, I could get no measures. She had outside bearings, and was apparently a much better engine than either of the other two, as to sinuous motion, but very disagreeable to ride upon. I rode upon her from Southampton to Basingstoke, and, therefore, had a fair opportunity of trying her both up and down hill. It appeared to me as though she had no springs behind, she was so exceedingly rough.

I traveled 106 miles on these three engines. It being dark when I was on the *Orion*, I had an opportunity of judging how far lights in front might be of any service, so as to prevent accidents. My opinion certainly is that no light, however strong, placed in front of an engine, will ever answer any useful purpose of apprizing the driver of an object before him in time to stop the train, if he is going at anything like a railway velocity. To be efficient under all circumstances, a light must be intense enough to illumine an object a mile off, in such a way that it shall be rendered visible to the man on the engine. Now, setting aside the difficulties of curves, &c., can any one imagine such a thing possible?

It has usually been said that an engine ought not to travel beyond 30 miles at a time, but this Company's engines travel two and a half times that distance, without any apparent inconvenince.

The South Western stock of engines is 48, four only of which have four wheels, all the rest being six wheel engines. The four wheel engines have inside bearings; the others have both inside and outside bearings on the crank axles. Of these engines, 42 in the middle of November were ready to take a train. The six wheel engines are said to cost £1,300; the four wheel, £1,000 each. The average gross load is 74 tons; the consumption of coke 34 lbs. per mile. They describe their six wheel engines as much steadier than their four, and prefer them on account of this quality and their greater safety; but they admit that any unsteady motions of the engines arise generally from imperfections of the road, as the primary cause. Their pressure in the boiler is 50 lbs. per inch. The total locomotive expense per mile, 18d., and the total miles run in one year, 600,000.

They have had no engines run off the line, and have made no returns as to how many broken axles, or detentions, they have had, from partial derangement of the engines. We believe the cause for this is the destruction of their records at the late fire. At present, we understand that no Company's engines work with more regularity, or fewer accidents. Railway Mag.

[TO BE CONTINUED.]

Mr. Vignoles' Lectures on Civil Engineering, at the London University College.

[CONTINUED FROM PAGE 85.]

On Earthwork.

Lecture V.—Wednesday, December 22nd, 1841.—The Professor commenced by stating that earthwork, taken in the present extended sense of the word, was but little known to the ancients. The gigantic operations in earthwork of modern times correspond with the viaducts of the ancients. Our earthwork may be confined to excavation, cutting, and embankment, or getting and filling, as ordinarily denominated by contractors. He then went through the whole process, giving the scientific and common names of each description of work. With respect to the works of the ancients, in the canal made by Cyrus, the Phœnicians were the only workmen who cut the canal with slopes; all the rest employed cut straight down, and, in consequence, the former stood, while the latter fell in. The River Po, in Italy, was a curious instance of embankment; this river is situated in a very flat country, and makes an annual deposit of a calcareous matter, which, hardening, raises the bed of the river in a slight degree every year. The ancient inhabitants, to prevent their country from being inundated, were obliged to raise a small embankment on each side of the river—perhaps two or three feet high—which, having served for some years the desired purpose, and the bed of the river having become higher from the deposit, the embankments required to have still more added to them, until, after the lapse of centuries, the bed of the river, from the constant deposit of calcareous matter, and the consequent necessary additions to the embankments, to the height of thirty feet, is now several feet above the level of the surrounding country. This work looks like one of our modern gigantic works, but it bears no comparison to the labors of the present day, it being but a work performed from year to year, in small portions at a time, while ours have been formed at one operation. From all his researches, he, therefore, came to this conclusion, that, until late years, earthwork was but little known; he could make the same remark with respect to cutting. This work was first treated systematically by military engineers, in fortifications on the continent, after the invention of cannon. Authors of that period lay down many curious rules for forming ramparts. Various useful calculations are given, to determine the best mode of making the matter taken from the ditch exactly sufficient to form the rampart, in order that there should be none either to procure or to carry away. The next is in the construction of canals; the same rules were followed as in the construction of ramparts. In road-making the same calculations were made; the whole aim of the engineer being to make the imaginary line, called the "balancing line," so perfect, that the earth removed from the eminences should fill up the hollows in the irregularities of the country through which the road was to be made. The cause of these fine calculations was the difficulty and expense of carrying away the superfluous earth to another place. The absence of great undertakings on the continent is attributable to the want of our modern appliances to get rid of the superabundant matter. In the contracts sent in by foreigners for works abroad, it is amusing to see the finical exactness with which the contractors calculate the expense of removing the first 100 yards, then the next 25 yards, and so on increasing, until they get to 300 yards, beyond which the price is enormous. It is only within the last three years that they seemed to have the slightest idea of the plans in use in England for facilitating this work; it is certainly not more than thirty years ago that we commenced using the tramroad. First of all, the only plan was to remove the earth in barrows; then the clumsy three-wheel cart was introduced; after that tramroads, and now edge-rails, with the application of a locomotive—so that thirty years have changed the load from 2½ cubic yards to nearly 100.

Before railroads came into general use, deep cuttings were executed, and one remarkable instance Telford has left behind him in the Birmingham Canal, which is remarkable for boldness of idea and success of execution. Near Market Drayton there is an embankment, began fifteen or sixteen years ago, and which is as yet hardly finished, so great has been the slipping, and so difficult the remedy. This work is a remarkable instance of the combined bad effects of a bad mixture; the slopes have flatted down until nearly in the proportion of 14 to 1, and it is now more like a large hill than an embankment. There is an instance of a deep cutting, by Dodd, at the Highgate archway; it was intended, first of all, to make a tunnel, but, from the constant slipping of the earth, it was obliged to be made into an open cutting. The present bold mode of cutting down large hills, and filling up deep vallies, in the formation of railways, is due to George Stephenson, and in the construction of large cuttings and embankments for canals, to Telford, whilst Dodd made the largest cuttings for roads. On the Holyhead road the failure of the embankments and cuttings in the London clay, will teach a good lesson to the young students. The point to be considered is, which, of masonry, aqueducts, tunneling, embankments, or cuttings, would be the cheapest mode of doing the work proposed. At the present time, earthwork is the cheapest, for modern practice has reduced it to a price per cubic yard. In the contracts for the Paris and Rouen Railway, the contracts sent in by the French engineers were invariably three or four times the amount of those sent in by English contractors. Thus, notwithstanding the expense of transporting the workmen into France, the whole of that work is in the hands of Englishmen.

The engineer, to form a just calculation, must well study the character and mechanical properties of the soil, and the necessary slopes. Experience alone can teach these points. There are many varieties of the London clay, which, when cut down to a certain depth, on exposure to the atmosphere, are sure to slip; another cause is, the great haste with which the embankments, &c., are formed. When the water does not penetrate, this clay is very hard; but after exposure, it melts away like tallow, and the only remedy is to get rid of the water by draining. When a slip takes place, the toe of the embankment bulges forward. In the first instance, the surface should be well drained a short distance from the edge—the drain to be puddled, in order that the water should not penetrate; borings should be made horizontally, and the water tapped; when expense and time are no objects, the whole should be cut in steps, and drained by means of wattles, so that if a slip takes place, it is only partial. The force with which the toe of the embankment bulges out is such, that a wall of masonry would be of no use, as it would be pushed out; the most effectual preventive, or remedy, is wattling and bush drains. When time will allow, it is better to make the embankments in layers, and between each layer of earth putting in a course of brushwood, clippings of hedges, or wattlings. When embankments are obliged to be poured out hastily, allow them to take their natural slope, and if it slips, let it remain; for however much it may be attempted to reduce it to its former shape, it will still again slip and regain its position. A good practice to provide against slips is, to form a slight abutment of earth a short distance from the toe of the slope, so that it should stay the slip if it takes place; this plan is more particularly available when the work is obliged to be erected on a natural slope—for instance, on the side of a hill. The Professor then, for the information of the younger students, explained, by diagrams, the nature of slopes, and the meaning of the expression "two feet to one," &c., and concluded by recommending that, in forming slopes, the engineer should run some risk of slips, in order to save the great expense of removing more earth than is actually necessary—the cost of repairing these slips being but little in comparison. He likened the work to an insurance on life, the risk to be run being calculated upon by precedents. The principle is to get the greatest extent of work finished at the least possible expense, and many of the great slips that have taken place might have been prevented, or speedily cured, had the plans he laid down been better followed.

Lecture VI.—Wednesday, December 29th, 1841.—Professor Vignoles stated that before continuing the subject of earthworks, he wished to set right an erroneous impression with the public, in consequence of an expression he made use of at his last lecture; he had then recommended that "the engineer should run some risk of slips, in order to save the great expense of removing more earth than was actually necessary—the cost of repairing these slips being but trifling in comparison." He need not say that he so expressed himself, but it was always on the supposition that no risk was to be run where there was the remotest probability of danger. He mentioned this because of the circumstance of the slip on the Great Western Railway, which was attended with such fatal results, and happening only a few hours after he had made that statement. From all that had been stated, it appeared that the slip itself was but very inconsiderable; the cutting where it took place was 57 feet deep, the slope two to one, and the width of the road 40 feet; the slip took place about half way up the bank. A number of smaller slips had occurred, and tiles were used for draining, instead of bushes, &c., to cure them—still the mode of curing them was the same as he advocated—by drainage. As he had before stated, the slip itself was very inconsiderable, but, by having nothing to check it, the earth fell upon the rails. A doubt seemed to exist whether the concussion produced in the air by the passing of the former train, had not brought it down, for the accident happened in the interval between the passing of the two trains—the first one having proceeded uninjured, whilst the latter was attended with such fatal consequences. If the precaution had been taken, when it was first observed that a slip was likely to occur, to put up a fence of hurdles to check its advance to the rails, doubtless, the accident would not have happened. The manner of the slip showed that it was caused solely by the infiltration of water, probably a considerable way back from the edge of the cutting, or, perhaps the water had found its way in by the ditch along the top; the water which had thus got into the soil having expanded during the frost, the sudden change of the weather brought down the earth. The Professor then, by means of a diagram, explained the nature of the cutting, from which it appeared that the "top lift" was deposited in spoil bank. At the top of the cutting, a drain had also been cut, but he was of opinion that such drains were injurious, when the soil was at all precarious. The spoil bank was not the occasion of the slip, since it did not take place at the top, but bulged out in the middle. Although this slip was very small, from the fatal effects which attended it, it was the more necessary to guard against the recurrence of the like. There were but a few feet of earth on the rails, yet the effect was the same as if so many planks had been placed upon them. The Croydon slip arose from the same cause, but, though so much larger, no accident occurred. In the late accident there were but thirty or forty wagon loads of earth, and all was right again in a few hours, while in the Croydon slip 3,000 or 4,000 cubic yards of earth fell; the soil in both instances consisted of the London clay, with potholes of sand. It was clear that the accident was not to be set down as one of cutting, similar slips having taken place upon cuttings not more than twelve or fourteen feet deep. He must impress upon the minds of the students that it was not the length or depth of the cuttings which regulated the slopes, but the soil and practicability of drainage; unfortunately it was impossible to know exactly how these matters might stand—experience alone could teach them. He had dwelt long upon this subject, but he wished it to be understood that it was well-judged economy he advocated, not such as would, in the least degree, tend to produce such fatal effects as in the case previously alluded to.

The balancing of the line was equally necessary for railroads as for canals or common roads; it should be the engineer's aim that the quantity of the earth from the cuttings should be as near as possible sufficient for the embankments; compared with former times, the mode of transit was so much facilitated, that where some years back it was necessary that the balance line should be limited to the hill to be cut through, and the valley to be filled up, now the line might extend two or three miles. It was essential in balancing that the engineer should be aware of the different degrees of compressibility of the matter; it was known of sand that it would occupy the same cubic contents in the embankment as it did in the hill, and one yard or 100 yards of gravel would be still the same; but in clays it was very different, they occupying less space in the embankment than they did in the hill, in their original position; 100 yards of clay would not make 100 yards of embankment, the average amount of compressibility being not less than ten per cent., or even, upon occasions, as much as 15 per cent. He had known occasions when 100 yards cut from a hill had only made 85 yards of embankment, but, upon an average, it would require 110 yards of clay to make 100 yards of embankment. Rock cuttings, on the contrary, expanded, because the solid rock could never again be restored to the same degree of density; the difference would vary much, according to the size of the fragments; but where the pieces were large, 100 yards would make 120 yards of embankment.* Chalk, again, would be rather upon the excess, though much depended upon its quality. In rock cuttings you might make them nearly perpendicular, but in chalk much discussion † has arisen as to what was the proper slope, some engineers having even recommended that it should overhang the road; but he contended that it should slope, to carry off the water. He had found a slope of one quarter to one generally sufficient. Rock chalk would stand perpendicular, while several of the softer descriptions would require a slope of one half to one, or even two to one.

The Professor then proceeded to speak of the correct mode of computing the quantity of earth in a cutting or embankment, and made a section of a hill half a mile long, to be cut down, the true cubic contents of a portion of which was 332,000 cubic yards, computed according to the prismoidal formula; but the ordinary method by which contractors would calculate the contents of the hill, by mean heights, would only show 310,000 cubic yards—that is to say, there would be a difference of 22,000 cubic yards against the contractor, the consequence of which had been, that the person contracting to cut down such a hill, at so much per yard, would lose, from his bad method of calculation, above £1,000. Another method was also in use—calculating by the mean area; which system, instead of 332,000 cubic yards, would show 376,000 cubic yards—being an excess in favor of the contractor of 44,000 cubic yards. Many contractors had realized large fortunes by mean areas, and sustained serious losses by mean heights. Having thus shown the erroneous methods of calculation in use, he then, at some length, explained the prismoidal formula, accompanying his instructions with many diagrams, without which, any attempt at explanation on our part would be useless. The learned Professor concluded his lecture by strongly recommending a close study of mathematics to the junior (all) students, as the greatest assistant to the labours of the civil engineer.

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* These remarks strongly corroborate those of an American engineer, inserted in th Journal of December last.—[Ed. C. E. & A. Jour.

† See the evidence on the Brighton Railway before the House of Lords.

Civ. Eng. & Arch. Jour.

(To be continued.)

Wooden Pavements.

In some of the English periodicals, lately received at the Institute, we notice statements to the effect, that pavements of wood are generally approved in England, are rapidly extending in London, and that even the Thames Tunnel *is to be paved with wood.*

From all this, we are induced to believe that some superior mode of laying and preserving these pavements has been adopted in England, which is yet unknown amongst us.

For here in the United States, *wooden pavements are regarded now as a decided failure,* so much so, indeed, that considerable surfaces of them are now about to be removed, both in New York and in this city, and replaced, partly, by cubical blocks of granite, and partly, by the ancient water-worn pebble stones, so long used in the American cities.

We should, therefore, feel indebted to our scientific cotemporaries on the other side of the water, if any of them would furnish for our information, through the columns of their valuable periodicals, a statement

I. Of the original cost, in London, of the finished wooden pavement per square yard.

II. Of the durability and annual repairs of the same.

III. Of the most approved mode of cutting and preparing the wooden blocks, forming the foundations, and laying the pavement ready for travel.

The great objection here urged against wooden pavements, is their *very rapid decay,* and the unpleasant nature of the traveling over them, as soon as they begin *to rot in holes;* which we find to take place, with those which have been here laid with hemlock timber, in the very short space of *about four years.* M.

Bibliographical Notice.

"*A descriptive and historical account of Hydraulic, and other, Machines for raising water, ancient and modern: with observations on various subjects connected with the Mechanic Arts, including the progressive development of the Steam Engine. Description of every variety of Bellows, Piston, and Rotary Pumps, —Fire Engines—Water Rams—Pressure Engines—Air Machines—Eolipiles, &c. Remarks on Ancient Wells—Air Beds—Cog Wheels—Blow Pipes—Bellows of various people—Magic Goblets—Steam Idols, and other machinery of ancient Temples. To which are added experiments on blowing and spouting tubes, and other original devices. Nature's modes and machinery for raising water. Historical notices respecting Siphons, Fountains, Water Organs, Clepsydræ, Pipes, Valves, Cocks, &c. In five books, illustrated by nearly three hundred engravings. By Thomas Ewbank.* New York, D. Appleton & Co., 8vo., pp. 582."

We have given the entire title of the work we are about to notice, deeming this necessary in order to convey a proper idea of its contents. The general object of its author is to furnish the history of the origin and progress of the various machines which have been invented and used for the raising of water; and the five books into which the volume is divided, treat, 1st. On primitive and ancient devices for raising water. 2nd. On machines for raising water by the pressure of the atmosphere. 3rd. On machines for raising water by compressure, independent of atmospheric influence. 4th. On machines for raising water, (chiefly of modern origin,) including early applications of steam for that purpose. 5th. Novel devices for raising water, with an account of siphons, cocks, valves, clepsydræ, &c., &c. To these five books is added an appendix, containing miscellaneous items on various matters related to the general subject.

We have long known that Mr. Ewbank was preparing this work for the press, and have looked for its publication with a conviction that we should derive much valuable information from its perusal; an expectation that has been fully justified by the result. It is not our design to give a regular review of this work; indeed, this would be hardly possible, as it is itself a review of the origin and progress of hydraulic machinery, and does not pretend to give a minute description of the individual machines to which it refers. Those who are acquainted with that very interesting work, "Beckman's History of Inventions," will form a pretty correct idea of the nature of the present work, when we say that there is much similarity in the general character of the two; the main difference being that Beckman treats briefly of the origin of inventions in general, relating to the useful arts, whilst Mr. Ewbank has limited his inquiries to a single, but comprehensive, class, with some of its genera, species, and varieties. The object of Beckman did not require the aid of the engraver, his subject being the origin of the arts, and not a description of any particular machines; whilst without the numerous illustrations given in the cuts in Mr. Ewbank's work, it would have been one of little value. There is in this respect, as well as in some others, a considerable resemblance between the book before us and Stewart's Anecdotes of the Steam Engine.

The reader of Mr. Ewbank's work will be disappointed should he expect to acquire from it a knowledge of the greater number of individual devices which have been introduced as improvements in hydraulic machinery; if he wishes to learn how the different kinds of pumps, or of valves, are constructed, he must, to acquire this knowledge, study other works; but if their history, from their rude beginnings to the state in which we now find them, is a matter of interest to him, he will find more in this work to gratify his curiosity respecting these, and numerous other inventions, than in any other which we could name.

We have said that Mr. Ewbank's book has been long in preparation for the press, and the evidence of this appears on almost every page; the authorities cited manifest unwearied, and very extended, research in books but little read, and difficult to obtain; and the manner in which the materials thus accumulated have been employed, reflects a very high degree of credit upon the author; whose life has not been that of a book-worm, but of a mechanic busily engaged in the working of metals; and who having by persevering industry acquired enough to render him independent of the melting-pot and the draw-bench, has been with equal diligence devoting himself to literature, in a department for which he had been fitted by his previous pursuits in business, and his habits of careful inquiry and observation. His work is not one which can fall still-born from the press, as it is not one of those ephemeral productions that must sell at the moment, or never; it is not an account of individual machines of recent invention, which are doomed to be superseded by the improvements of to-morrow; its historical details will be as useful, and the remarks upon them as interesting, half a century hence as they are at the present day.

From the nature of the work, it is miscellaneous in its character, and the materials which enter into its composition, might, undoubtedly, have been disposed in somewhat better order; but the former part, we are told, was stereotyped before the latter portions were written.

There are here, and there, some reflections and opinions relating to the political organization of society, which, however true in themselves, might have been advantageously omitted, as they are not only foreign to the subject of the work, but are, in some cases, calculated to offend; this we consider as a blemish, which is not fully redeemed by the many well conceived and happily expressed observations that render the book, as a whole, highly creditable to its author, who has himself anticipated the foregoing objection.

We have not made any extracts from the work, because it is our intention, at an early day, to republish some entire articles from it, which will exhibit its character more perfectly than could be done in the space allotted to this notice.

Notice of the United States Almanac, for 1843. *By* S. C. Walker.

We have been favored with the inspection of the printed sheets of a forthcoming work, by John Downes, entitled "The United States Almanac, for 1843."

Mr. Downes is favorably known to our readers, by his announcement of the lunar occultations of the fixed stars, which appeared in this Journal in 1841; these were interrupted by his engagements in the North Eastern Boundary Exploration, under Maj. Graham. As the Boundary question is now settled, we may indulge in a hope that these useful announcements will soon be resumed. The astronomical and engineering department of this work contains about one hundred pages of close print, embracing a complete calender, suited to any part of North America, from 10° to 50° North. The columns of the times of rising and setting of the sun and moon, and of high and low tides, are of sufficient compass for all this region. To the practical astronomer the work commends itself, by the general discussions of the Solar Eclipse of June 27th, 1843, which is visible in part of Louisiana, in Mexico, Texas, West Indies, and South America; also by the table of selected occultations, visible in North America, of stars, down to the seventh magnitude, inclusive. In preparing it, reference must have been made to the original star catalogues, as there is no general list of this kind published in Europe below the sixth magnitude. A list like this serves to form the basis for computing such special series for Philadelphia as have hitherto appeared, and will we hope again appear, in the Journal. The particulars respecting the planets and asteroids, are given with sufficient minuteness for the amateur, though not, perhaps, for the practical astronomer. Quite different is the case with the Ephemeris of the sun and stars, which are taken from the Nautical Almanac, and are reprinted in full. This dependency of American savans upon Europeans, must continue so long as the country is destitute of the establishment of a nautical almanac of its own. The computations required exceed the means of any individual. The Lunar Ephemeris is of course only popular. Enough is given for the amateur. The practical navigator and astronomer must still resort to the British Nautical Almanac, or Blunt's reprint of the same, which alone would exceed the entire space here devoted to the calander and accompaniments. Mr. Downes has appended several useful tables for engineers; his tables for finding latitude and time by equal altitudes, for reduction to the meridian, for refractions, for measure of heights by the barometer, are all of the most approved construction, and such as a person engaged in field labor must find indispensable. The want of such tables in a portable form must, doubtless, have been felt by Mr. Downes, in the Boundary survey. The table for computing the heights of mountains by barometric observations, is taken from Bessel's paper in Schumacher's Astronomical Notices, vol. xv, Nos. 356 and 357, or rather from a reprint of the same, in a more popular form, in Schumacher's Jahrbuch, for 1840. Bessel's tables for computing heights by the barometer, have an important advantage over all the others that preceded them, in taking into account the degree of saturation of the atmosphere with vapor, or, in other words, the temperature of the dew point. The tables in use previous to Bessel's, were usually founded on Laplace's formulæ in the Mécanique Céleste. The simplest arrangement of the computation was contrived by Gauss, and has been reprinted by Baily in his "Astronomical Tables and Formulæ." These suppose a mean state of the atmosphere in respect to moisture, but make no allowance for the actual degree of saturation. Bessel's tables, when the mean condition of the atmosphere is supposed, agree very well with those of Gauss; but they go farther, and enable us to point out the correction required in the computed heights of stations for a rise or fall of the temperature of the dew point. As this subject is new to most of the readers of the Journal, we subjoin the following table, computed by Bessel, for the purpose of showing the maximum error which may arise from overlooking altogether the correction for the moisture of the atmosphere, or, in other words, the supposition of complete dryness.

An inspection of this table is sufficient to show the necessity of attending to this correction—for example, when the half sum of the temperatures is 68°, and the difference of altitude 10,000 feet, the maximum effect of a saturation with vapor on the result is 105 feet. The mean ordinarily used is 52.5 feet, which is the greatest error that can be committed in this case, by supposing the atmosphere to be in a mean state of moisture.

We have been led into this digression by the consideration of the importance of this element in the discussion of the meteorological registers recently published in this Journal.

Difference of Altitude in Toises.	Half Sum of the Temperatures of the Air, in Degrees of the Centigrade Thermometer. 0°	10°	20°
T.	T.	T.	T.
500	1.36	2.55	4.64
1000	2.90	5.41	9.83
1500	4.62	8.61	15.60
2000	6.55	2.18	22.02
2500	8.70	16.15	29.14
3000	11.10	20.55	37.02
Difference of Altitude in English feet.	The same for Fahrenheit. 32°	50°	68°
Feet.	Feet.	Feet.	Feet.
3197.3	8.70	16.31	29.67
6394.6	18.55	34.60	62.85
9593.2	29.54	55.06	99.76
12789.2	41.89	77,89	140.81
15986.5	55.64	103.27	186.33
19183.8	70.98	131.40	236.72

On the whole, we must conclude that the Ephemeris is the most complete manual for the surveyor, topographical engineer, and practical astronomer, that has yet appeared in this country, in a form suitable for the pocket.

The geographical and statistical part of the work fills the remaining two hundred pages, and gives a list of the principal cities, ports, naval and military stations, with their appropriate latitudes and longitudes, from the best and most recent authorities. Then follows the herculean work of a digest of the census of 1840; this has been effected from the general table of statistics published in folio by Congress, so as to give, under an alphabetical arrangement, every town, county, territory, and state, in the Union, that has a local habitation and a name, with their respective populations, according to this census. The work contains, also, an epitome of the *blue* book, and will be of great use to office-holders and expectants of office, under the federal, state, or municipal governments. Every post-officer whose salary exceeds $500 is mentioned, and the location of his post-office is given. Full information is furnished respecting foreign and home diplomatic agents, the principal officers of the army and navy list, the executive cabinets, the auditors, collectors, consuls, &c., and their salaries. The work also contains full tables relative to the commerce, imports, and exports of the country, during the several presidential terms; the aggregate value, produce, capital invested, and persons employed, in every department of commerce, and manufactures, and produce of the country. These tables contain highly useful information; they have been compiled from the census returns made by the marshals of the several districts in the United States. Another important item—that of the state debts—is stated at full, with the date when, and purposes for which, they were contracted; the causes of the unprofitableness of the public works of some of the states, and of their success in others. The work also contains an estimate of the rate of increase of the population of the United States for every ten years, since 1790, with estimates for 1850, '60, and '70; thus it appears that the average ten year increase has been $34\frac{15}{100}$ per cent—at which rate the population would amount, in 1870, to about forty-one millions.

As the subject is one of great importance, and as it may be desirable to know the amount of our population at intermediate periods between the censuses, we have endeavored to deduce from a discussion of the six censuses from 1790 to 1840, inclusive, the most plausible analytical expression of this population, any year. The method employed consists in considering these six censuses as six terms of a series, of which the generating function is required.

Let P_n = the population of the United States at any date n.
P_m = the same at any other date m.
r_n = the rate of increase of the population for the year whose middle has the date n.

Then if we suppose r to vary according to the powers of the intervals in years $(m—n)$, we have between P_n and P_m the following equation:

$$(1) \cdots\cdot P_n = P_m \left(r_n + A \cdot (m-n) + B \cdot (m-n)^2 + C \cdot (m-n)^3 + \&c. \right)^{(m-n)}$$

or,

$$(2) \cdots\cdot \left(\frac{P_n}{P_m} \right)^{\frac{1}{m-n}} = r_n + A \cdot (m-n) + B \cdot (m-n)^2 + C \cdot (m-n)^3 + \&c.$$

in which, A, B, C, &c., are the unknown constant co-efficients of the successive powers of the interval $(m—n.)$ Giving to n the value of 1840, and to m the successive dates of the first five censuses, which we take from the table given by Mr. Downes, and which is reported below, and neglecting the third and higher powers of the interval $(m—n)$, on account of the smallness of the number of censuses, or terms of the series, we find, by means of the last formula,

$$
\begin{aligned}
\text{for } m &= 1790;\; r_{1840} - 50\,A - 2500\,B = 1.0298086 \\
&= 1800;\; r_{1840} - 40\,A - 1600\,B = 1.0296412 \\
&= 1810;\; r_{1840} - 30\,A - 900\,B = 1.0290009 \\
&= 1820;\; r_{1840} - 20\,A - 400\,B = 1.0289878 \\
&= 1830;\; r_{1840} - 10\,A - 100\,B = 1.0286688
\end{aligned} \tag{3}
$$

Whence

$$
\begin{aligned}
v_0 &= A + 90\,B + 1674\,.\,(10)^{-8} \\
v_1 &= A + 70\,B + 6403\,.\,(10)^{-8} \\
v_2 &= A + 50\,B + 131\,.\,(10)^{-8} \\
v_3 &= A + 30\,B + 3190\,.\,(10)^{-8}
\end{aligned}
$$

And by least squares

$$
\begin{aligned}
A &= -7641\,.\,(10)^{-9} + 0.6722 \times \eta - 0.0098 \times \xi \\
B &= -316\,.\,(10)^{-9} + 0.0000 \times \eta - 0.0098 \times \xi
\end{aligned}
$$

These in No. (3) give

$$
\begin{aligned}
(r_n)_0 &= 1.0286365 \\
(r_n)_1 &= 1.0288300 \\
(r_n)_2 &= 1.0284873 \\
(r_n)_3 &= 1.0287086 \\
(r_n)_4 &= 1.0285608 \\
\text{Mean } r_n &= 1.02864464 = r_{1840}
\end{aligned}
$$

These values of r_n, A, and B, in No. (1), give for the population of the United States for any year denoted by m, the value of $P_m =$

$$17{,}068{,}666.\left[1.028644640 + 7641.(10)^{-9}(1840-m) + 316.(10)^{-9}(1840-m)^2\right]^{(m-1840)}$$

The following table contains the population of the United States for the decades from 1750 to 1900, inclusive, as derived from this formula, compared with the actual census. A formula which, reckoning backwards from 1840 to 1790, represents the population of the United States, with a maximum error of 38,000, and with a sum of errors of 95,000, in an aggregate of 56,000,000, must afford a plausible estimate for two or three censuses to come. It is impossible by the censuses before and since 1800, and 1810, to interpolate the values of the two latter. Can it be that the disturbed state of Europe and the West Indies, from 1790 to 1800, caused an excess of immigration to the United States of about 40,000, of which the greater part returned, under the more settled and consolidated governments from 1800 to 1810? Can any portion of the emigration, or falling off of the immigration in the latter period, be attributed to the restrictions upon commerce incident to the state of the times and to our domestic policy? We leave the subject to the decision of political economists.

Date.	POPULATION OF THE UNITED STATES.		
	By Census.	By Formula.	Discrepancy.
1750		1,015,000	
1760		1,455,000	
1770		2,054,000	
1780		2,859,000	
1790	3,929,827	3,928,000	— 2,000
1800	5,305,940	5,344,000	+ 38,000
1810	7,239,814	7,207,000	— 33,000
1820	9,638,191	9,650,000	+ 12,000
1830	12,866,020	12,856,000	+ 10,000
1840	17,068,666	17,068,666	0.000
1850		22,629,000	
1860		30,007,000	
1870		39,890,000	
1880		53,200,000	
1890		71,000,000	
1900		97,000,000	

Physical Science.

On the Chemical Statics of Organized Beings. By M. Dumas.

[CONTINUED FROM PAGE 92.]

III. Let a seed be thrown into the earth, and be left to germinate and develope itself; let the new plant be watched until it has borne flowers and seeds in its turn, and we shall see, by suitable analyses, that the primitive seed, in producing the new being, has fixed carbon, hydrogen, oxygen, azote, and ashes.

Carbon.—The carbon originates essentially in carbonic acid, whether it be borrowed from the carbonic acid of the air, or proceed from that other portion of carbonic acid which the spontaneous decomposition of manures continually gives out in contact with the roots.

But it is from the air especially that plants most frequently derive their carbon. How could it be otherwise, when we see the enormous quantity of carbon which aged trees, for example, have appropriated to themselves, and yet the very limited space within which their roots can extend? Certainly, when a hundred years ago the acorn germinated, which has produced the oak that we now admire, the soil on which it fell did not contain the millionth part of the carbon that the oak itself now contains. It is the carbonic acid of the air which has supplied the rest, that is to say, nearly the whole.

But what can be clearer and more conclusive than the experiment of M. Boussingault, in which peas, sown in sand, watered with distilled water, and having no aliment but air, have found in that air all the carbon necessary for development, flowering, and fructification?

All plants fix carbon, all borrow it from carbonic acid; whether this be taken directly from the air by the leaves, whether the roots imbibe within the ground the rain water impregnated with carbonic acid, or whether the manures, whilst decomposing in the soil, supply carbonic acid, which the roots also take possession of to transmit it to the leaves.

All these results may be proved without difficulty. M. Boussingault observed that vine leaves which were enclosed in a globe took all the carbonic acid from the air directed across the vessel, however rapid the current. M. Boucherie also observed enormous quantities of carbonic acid escape from the divided trunk of trees in full sap, evidently drawn by the roots from the soil.

But if the roots imbibe this carbonic acid within the earth, if this passes into the stalk and thence into the leaves, it ends by being exhaled into the atmosphere, without alteration, when no new force intervenes.

Such is the case with plants vegetating in the shade or at night. The carbonic acid of the earth filters through their tissues, and diffuses itself into the air. We say that plants produce carbonic acid during the night; we should say, in such a case, that plants transmit the carbonic acid borrowed from the soil.

But let this carbonic acid, proceeding from the soil or taken from the atmosphere, come into contact with the leaves or the green parts, and let the solar light, moreover, intervene, then the scene all at once changes.

The carbonic acid disappears; bubbles of free oxygen arise on all the parts of the leaf, and the carbon fixes itself in the tissues of the plant.

It is a circumstance well worthy of interest, that these green parts of plants, the only ones which up to this time manifest this admirable phenomenon of the decomposition of carbonic acid, are also endowed with another property not less peculiar, or less mysterious.

In fact, if their image were to be transferred into the apparatus of M. Daguerre, these green parts are not found to be reproduced there; as if all the chemical rays, essential to the Daguerrian phenomena, had disappeared in the leaf, absorbed and retained by it.

The chemical rays of light disappear, therefore, entirely in the green parts of plants; an extraordinary absorption, doubtless, but which explains, without difficulty, the enormous expense of chemical force necessary for the decomposition of a body so stable as carbonic acid.

What, moreover, is the function of this fixed carbon in the plant? for what is it destined? For the greater part, without doubt, it combines with water or with its elements, thus giving birth to matters of the highest importance for the vegetable.

If twelve molecules of carbonic acid are decomposed and abandon their oxygen, the result will be twelve molecules of carbon; which, with ten molecules of water, may constitute either the cellular tissue of plants, or their ligneous tissue, or the starch and the dextrine which are produced from them.

Thus, in any plant whatever, nearly the entire mass of the structure, (charpente,) formed as it is of cellular tissue, of ligneous tissue, of starch, or of gummy matters, will be represented by twelve molecules of carbon united to ten molecules of water.

The ligneous part which is insoluble in water, the starch, which gelatinises (l'amidon, qui fait empois) in boiling water, and the dextrine which dissolves so easily in water cold or hot, constitute, therefore, as M. Payen has so well proved, three bodies possessing exactly the same composition, but diversified by a different molecular arrangement.

Thus, with the same elements, in the same proportions, vegetable nature produces the insoluble walls of the cells of cellular tissue and of the vessels, or the starch which she accumulates as nourishment around buds and embryos, or the soluble dextrine which the sap can convey from one place to another for the wants of the plant.

How admirable is this fecundity, which out of the same body can make three different ones, and which allows of their being changed one into the other, with the slightest expense of force, every time occasion requires it!

It is also by means of carbon united with water, that the saccharine matters so frequently deposited in the organs of plants for peculiar purposes, which we shall shortly mention, are produced. Twelve molecules of carbon and eleven molecules of water form the cane sugar. Twelve molecules of carbon and fifteen molecules of water make the sugar of the grape.

These ligneous, amylaceous, gummy, and saccharine matters, which carbon, taken in its nascent state, can produce by uniting with water, play so large a part in the life of plants, that, when they are taken into consideration, it is no longer difficult to understand the important part that the decomposition of carbonic acid performs in plants.

Hydrogen.—In the same manner that plants decompose carbonic acid for the appropriation of its carbon, and in order to form together with it all the neutral bodies which compose nearly their entire mass; in the same way, and for certain products which they form in less abundance, plants decompose water and fix its hydrogen. This appears clearly from M. Boussingault's experiments on the vegetation of peas in closed vessels. It is still more evident from the production of fat or volatile oils so frequent in certain parts of plants, and always so rich in hydrogen. This can only come from water, for the plant receives no other hydrogenated product than the water itself.

These hydrogenated bodies, to which the fixation of the hydrogen borrowed from the water gives birth, are employed by plants for accessory uses. They form, indeed, the volatile oils which serve for defence against the ravages of insects; fat oils or fats, which surround the seed, and which serve to develope heat by oxidation (en se brûlent) at the moment of germination; waxes with which leaves and fruits are covered so as to become impermeable to water.

But all these uses constitute some accidents only in the life of plants; thus the hydrogenated products are much less necessary, much less common, in the vegetable kingdom, than the neutral products formed of carbon and water.

Azote.—During its life, every plant fixes azote, whether it borrows the azote from the atmosphere, or takes it from the manure. In either case it is probable that the azote enters the plant, and acts its part there only under the form of ammonia or of nitric acid.

M. Boussingault's experiments have proved that certain plants, such as Jerusalem artichokes, borrow a great quantity of azote from the air; that others, such as wheat, are, on the contrary, obliged to derive all theirs from manure: a valuable distinction for agriculture; for it is evident that all cultivation should begin by producing vegetables which assimilate azote from air, to rear by their aid the cattle which will furnish manure, and employ this latter for the cultivation of certain plants which can take azote from the manures only.

One of the most interesting problems of agriculture consists, then, in the art of procuring azote at a cheap rate. As for carbon, no trouble need be taken about it; nature has provided for it; the air and rain water suffice for it; but the azote of the air, that which the water dissolves and brings with it, the ammoniacal salts which rain water itself contains, are not always sufficient. With regard to most plants the cultivation of which is important, their roots should also be surrounded with azotated manure, a permanent source of ammonia or of nitric acid, which the plant appropriates as they are produced. This, as we know, is one of the great expenses of agriculture, one of its great obstacles, for it possesses only the manure which is of its own production. But chemistry is so far advanced in this respect, that the problem of the production of a purely chemical azotated manure cannot be long in being resolved.

M. Schattenman, the skilful director of the manufactories of Bouxvilliers in Alsace, M. Boussingault, and M. Liebig have turned their attention to the functions of ammonia in azotated manures. Recent trials show that the nitric acid of the nitrates also merit particular attention.

But for what purpose is this azote, of which plants seem to have such an imperious want? M. Payen's researches partly teach us; for they have proved that all the organs of the plant, without exception, begin by being formed of an azotated matter analogous to fibrine, with which at a later period are associated the cellular tissue, the ligneous tissue, and the amylaceous tissue itself. This azotated matter, the real origin of all the parts of the plant, is never destroyed; it is always to be found, however abundant may be the non-azotated matter which has been interposed between its particles.

This azote, fixed by plants, serves, therefore, to produce a concrete fibrinous substance, which constitutes the rudiment of all the organs of the vegetable.

It also serves to produce the liquid albumen which the coagulable juices of all plants contain; and the caseum, so often confounded with albumen, but so easy to recognise in many plants.

Fibrin, albumen, and caseum exist, then, in plants. These three products, identical in their composition, as M. Vogel has long since proved, offer a singular analogy with the ligneous matters, the amidon, and the dextrine.

Indeed, fibrin is, like ligneous matter, insoluble; albumen, like starch, coagulates by heat; caseum, like dextrine, is soluble.

These azotated matters, moreover, are neutral, as well as the three parallel non-azotated matters; and we shall see that by their abundance in the animal kingdom they act the same part that these latter exhibited to us in the vegetable kingdom.

Besides, in like manner as it suffices for the formation of non-azotated neutral matters, to unite carbon with water or with its elements, so, also, for the formation of these azotated neutral matters, it suffices to unite carbon and ammonium with the elements of water; forty-eight molecules of carbon, six of ammonium, and seventeen of water, constitute, or may constitute, fibrin, albumen, and caseum.

Thus, in both cases, reduced bodies, carbon or ammonium, and water, suffice for the formation of the matters which we are considering, and their production enters quite naturally into the circle of reactions, which vegetable nature seems especially adapted to produce.

The function of azote in plants is therefore worthy of the most serious attention, since it is this which serves to form the fibrin which is found as the rudiment in all the organs; since it is this which serves for the production of the albumen and caseum, so largely diffused in so many plants, and which animals assimilate or modify according to the exigencies of their own nature.

It is in plants, then, that the true laboratory of organic chemistry resides. Thus, carbon, hydrogen, ammonium, and water are the principles which plants elaborate: ligneous matter, starch, gums, and sugars on the one part, fibrin, albumen, caseum, and gluten on the other, are, then, the fundamental products of the two kingdoms; products formed in plants, and in plants alone, and transferred by digestion into animals.

Ashes.—An immense quantity of water passes through the vegetable during the period of its existence. This water evaporates at the surface of the leaves, and necessarily leaves, as residue, in the plant the salts which it contained in solution. These salts compose the ashes, products evidently borrowed from the earth, to which, after their death, vegetables give it back again.

As to the form in which these mineral products deposit themselves in the vegetable tissue, nothing can be more variable. We may remark, however, that among the products of this nature, one of the most frequent and most abundant is that pectinate of lime discovered by M. Jacquelain in the ligneous tissue of most plants.

IV. If, in the dark, plants act as simple filters which water and gases pass through; if, under the influence of solar light, they act as reducing apparatus which decompose water, carbonic acid, and oxide of ammonium, there are certain epochs and certain organs in which the plant assumes another, and altogether opposite, part.

Thus, if an embryo is to be made to germinate, a bud to be unfolded, a flower to be fecundated, the plant which absorbed the solar heat, which decomposed carbonic acid and water, all at once changes its course. It burns carbon and hydrogen; it produces heat; that is to say, it takes to itself the principal characters of animal life.

But here a remarkable circumstance reveals itself. If barley or wheat is made to germinate, much heat, carbonic acid and water are produced. The starch of these grains first changes into gum, then into sugar, then it disappears in producing carbonic acid, which the germ is to assimilate. Does a potato germinate, here, also, it is starch which changes into dextrine, then into sugar, and which at last produces carbonic acid and heat. Sugar, therefore, seems the agent by means of which plants develope heat as they need it.

How is it possible not to be struck from this with the coincidence of the following facts? Fecundation is always accompanied by heat. Flowers as they breathe produce carbonic acid: they therefore consume carbon; and if we ask whence this carbon comes, we see, in the sugar cane, for example, that the sugar accumulated in the stalk has entirely disappeared when the flowering and fructification are accomplished. In the beet root, the sugar continues increasing in the roots until it flowers; the seed-bearing beet contains no trace of sugar in its root. In the parsnip, the turnip, and the carrot, the same phenomena take place.

Thus, at certain epochs, in certain organs, the plant turns into an animal; it becomes, like it, an apparatus of combustion; it burns carbon and hydrogen; it gives out heat.

But, at these same periods, it destroys in abundance the saccharine matters which it had slowly accumulated and stored up. Sugar, or starch turned into sugar, are, then, the primary substances by means of which plants develope heat as required for the accomplishment of some of their functions.

And if we remark with what instinct animals, and men too, choose for their food just that part of the vegetable in which it has accumulated the sugar and starch which serve it to develope heat, is it not probable, that, in the animal economy, sugar and starch are also destined to act the same part, that is to say, to be burned for the purpose of developing the heat which accompanies the phenomenon of respiration?

To sum up, as long as the vegetable preserves its most habitual character, it draws from the sun heat, light, and chemical rays; from the air it receives carbon; from water it takes hydrogen; azote from the oxide of ammonium, and different salts from the earth. With these mineral or elementary substances, it composes the organised substances which accumulate in its tissues.

They are ternary substances, ligneous matter, starch, gums, and sugars.

They are quaternary substances, fibrin, albumen, caseum, and gluten.

So far, then, the vegetable is an unceasing producer; but if at times, if to satify certain wants, the vegetable becomes a consumer, it realises exactly the same phenomena which the animal will now set before us.

[TO BE CONTINUED.]

Description of an Electric Thermometer. *By* E. Solly, *Jun., Esq.*

I am induced to send the following account of a little thermo-electric arrangement, believing that it may be interesting; for although there is little or no novelty in the principles on which its action depends, I am not aware that it has been before practically employed.

I had for some time experienced considerable inconvenience in conducting certain experiments requiring a long-continued and uniform degree of heat, from the difficulty of regulating the temperature of my furnace, and the constant uncertainty whether everything was proceeding satisfactorily during my absence from the laboratory. I had, in consequence, often thought of the possibility of so arranging a little thermo-electric apparatus, that it might serve as an index of the rate of combustion and consequent heat of the furnace, by the deflection of a galvanometer at a distance from the source of heat. A small thermo-electric battery might be so placed that the one series of joints, or solderings, should be constantly exposed to the heated surface of the furnace; but a serious obstacle presented itself to any contrivance of this kind, which was, the difficulty of keeping the alternate joints of the battery cool. A current of electricity would doubtless be evolved, in consequence of the difference of temperature existing between the two sides of the battery; but, of course, as the heat would gradually traverse from the hotter to the cooler side, it would greatly diminish and modify the results, and thus present false indications of temperature—whilst even if it were possible to keep the one side of the battery cool, either by water or by any other means, yet the value of the deflection of the galvanometer would be always uncertain, as the difference between the two sides of the battery could never be ascertained unless the exact reduction of temperature thus caused were correctly known.

After one or two unsuccessful attemps to overcome this objection, I laid aside the battery, and substituted in its place a single pair of metallic elements, which I found gave abundance of power, and was not liable to the defect which the use of the battery involved.

A piece of copper wire, one-twenty-fourth of an inch in diameter, and of sufficient length to reach from the furnace to my ordinary sitting room, was joined by twisting the ends to a similar wire of soft iron—the ends of both having been previously well cleaned with sand paper. The two wires were then secured in a convenient manner, by small nails, to the walls of the rooms they had to pass through, care being taken that they were not anywhere in contact with each other, except at the two extreme points of junction; the one of these was so placed in the flue of the furnace that it was completely exposed to the action of the hot air and smoke at that part where the flue left the body of the furnace, whilst the other joint was in my room, in contact with a thermometer and surrounded with cotton, so as to render it as little as possible liable to sudden changes of temperature. The copper wire was then divided about a foot from the joint thus protected. The two ends of the wire were connected with the extremities of a galvanometer coil, and the apparatus was complete.

A metallic circuit was thus made, consisting of two elements—the one being the iron wire, and the other the copper wire, including the additional length of copper wire in the coil of the galvanometer. The one joint, or point of contact, was, of course, always far hotter than the other, and would necessarily remain so, so long as the fuel in the furnace continued to burn, and would be dependent on the rate of combustion in the furnace; whilst the other junction would always remain very nearly at the temperature of the air, and its variations could be readily known by the thermometer in contact with it. A current of electricity was thus generated, proportioned to the difference of temperature between the two joints, and a deflection of the galvanometer was caused, which increased when the furnace became hotter, decreased when it cooled, and at all times indicated accurately the changes of temperature taking place—thus giving me a thermometer which indicates, without my moving from the table, the exact rate of combustion going on in the furnace, which is fifty yards distant from the indicator. I believe that it is commonly supposed that weak thermo-electric currents cannot be well made to traverse small wires of any length, and this is probably the reason why this beautifully manageable power has been so little employed for practical uses. I have received so much satisfaction from the arrangement just described, that I am convinced it would be found a very useful indicator of temperature in stoves, flues, and hot pipes, in many situations where a common thermometer is inapplicable.

The cost of such an apparatus must necessarily be more expensive than any thermometer, but then it must be remembered that it does far more than an ordinary thermometer, giving us the means of knowing the temperature of a stove, or furnace, at a distance; giving us indications of the least change or variation in the source of heat, with even greater certainty and distinctness than a thermometer; and besides, showing these changes so rapidly, that we know whether it is becoming hotter or colder, before a thermometer, placed on the outside of the stove, indicates any change. I have observed, on comparing the thermo-electric with an ordinary thermometer, placed on the iron plate forming the top of the furnace, that if the ash-pit door were closed, or the draught in any other way diminished, the deflection of the galvanometer was immediately reduced, whilst the external thermometer continued to rise for some little time; and that the indications given by the galvanometer of the augmentation or decrease of temperature in the furnace, always preceded the same indications from the mercurial thermometer on the top.

London, October 20, 1841.

Lond. & Ed. Philos. Mag.

On the Mouths of Ammonites, and on other Fossils, found in the Oxford Clay, near Christian Malford, on the Line of the Great Western Railway. By MR. C. PEARCE.

The section exhibited at the point where Mr. Pearce obtained his specimens was at follows:

1. Alluvial soil,	2 feet.
2. Gravel,	8 "
3. Beds of laminated clay, alternating with layers of sandy clay, chiefly composed of broken shells,	6 "

The fossils described in the paper were procured from No. 3, and consisted of crustaceans, which the author conceives inhabited the dead shells of the Ammonite, and to which he applies the generic name of Ammonicolax, of numerous bivalves and univalves, of Ammonites, with the mouths beautifully preserved, Belemnites, and an allied genus, for which he proposes the name of Belemnoteuthis. Of many of these fossils detailed specific characters are given, but as they do not admit of abridgement, we must confine our notice to the author's remarks on the structure of the mouth of the ammonite. Mr. Pearce is of opinion that the lip, or perfect termination, assumes a different shape in almost every species, and that it has a simpler form in the adult, or full grown shell, than in immature individuals. For several years he has remarked, that specimens of what he considered to be full grown ammonites, with a perfect lip, had a nearly straight, or slightly waved, margin, whilst smaller, and as he conceives younger, shells, of the same species, possessed, in many instances, lateral prolongations, equalling, occasionally, in length, as he has recently observed, five-sixths of the diameter of the fossil. During the growth of the shell these processes, he is of opinion, were successively absorbed and reproduced, but were never added to the final lip. From an extended examination of ammonites belonging to various rocks, Mr. Pearce infers, that in the young shell, provided with lateral projections, the animal filled not merely the whole of the last chamber, but extended beyond it, and thereby guarded the processes from injury, and received support, or protection, from them. On the contrary, the last chamber of the mature shell having been, he believes, sufficiently large to receive the whole of the soft parts of the animal, the lateral appendages were not required, and, consequently, were not added to the lip. In the course of the paper, some remarks were offered on other species of ammonites, which apparently never possessed lateral processes at any period of growth, but are characterized by contractions, or expansions, of the shell, at certain points; and in those cases, Mr. Pearce concludes that the additions were made without the absorption of the old mouths.—*Transactions Geolog. Soc.*

Athenæum.

Notice of the Occurrence of Fossil Plants in the Plastic Clay at Bournemouth, Hants. By the Rev. P. B. Brodie.

To the east of Bournemouth, the cliffs consist of white and yellow sands belonging to the plastic clay, and as they range along the shore they increase in height—beds of clay, full of vegetable remains, appearing under the sands. About half a mile from this point they are composed of alternations of white, grey, and yellow, sand, overlaid by strata of clay, divided by thin layers of vegetable matter. In a bed of white sand, near the middle of the cliff, are impressions of ferns; and a layer of sandy clay is full of small leaves. Somewhat farther, are strata of sand and sandy clay, abounding with beautiful vegetable remains. The plants are frequently so well preserved that the epidermis peels off when the specimen is exposed, and they are stated, by the author, to belong to genera of a warmer climate than that which now prevails in Great Britain. Ibid.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1841.

With Remarks and Exemplifications by the Editor.

1. For an improvement in *Fire Engines;* Joseph B. Babcock, Marietta, Washington county, Ohio, July 1.

The cylinders and pistons, or plungers, are placed horizontally, and these cylinders, with the part of the apparatus to which they are attached, are secured down to the bottom of the cistern. The pistons, or plungers, are hollow, and are provided with valves for the admission of the water into the cylinders; they are attached to the ends of a square frame, inside, the side pieces of which are provided with racks, into which the teeth of two segment cog wheels work, said segments being attached to the brake.

Claim.—"What I claim is the manner in which I have constructed, arranged, and combined, two horizontal hollow pistons, with the horizontal cylinders affixed to the bottom of the cistern of a fire engine, and also with the vibrating frame and segment wheels; the whole being constructed and operating as set forth. I do not claim either of these parts separately and individually, but I do claim so to have combined them as to produce an instrument new in its construction, and useful in its operation."

2. For an improvement in the *Bee Hive;* John M. Weeks, Salisbury, Addison county, Vermont, July 1.

"What is claimed as constituting the invention, and not previously known in bee hives, is the mode of regulating the ventilation of the hive by means of tubes lined with wire gauze, and having apertures to which the adjustable caps, perforated with similar apertures, are adapted; the whole being constructed in the manner set forth. Also, combining with the central box, or line, one or more collateral boxes, containing smaller hives, in combination with the mode of ascertaining and regulating the temperature of the hives, by means of thermometrical and ventilating apparatus; the whole being constructed, and operating, substantially in the manner described."

3. For an improvement in the *Horse Power;* Thomas J. Wells, New York city, July 1.

This horse power is actuated by belts, instead of by cog wheels; the horse sweep turns on a centre pin, in the middle of a circular platform, around which a band passes, that extends to, and around, a small wheel, the axle of which has its bearings near the outer extremity of the sweep. On the upper end of this axle there is a band wheel, from which a band extends to a small wheel, turning on the same pin with the horse sweep; connected to this small wheel, and turning with it, there is a large wheel, from which a band extends to any machine to be driven.

Claim.—"I do not claim as my invention the mere substitution of a band for cogged wheels, in the construction of a horse power; nor do I claim simply placing the double wheels on the horse sweep, or lever, to travel around the main, or stationary, wheel, as this has been heretofore done with cog wheels having the axis of the traveling wheels within the periphery of the main wheel, the cogs of which were put on the inner periphery thereof; but what I do claim as my invention, and desire to secure by letters patent, is placing the traveling wheels on the sweep without the periphery of the main, or stationary, wheel, in combination with the employment of bands, as herein described."

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4. For improvements in the *Steam Boiler and Evaporator;* Oran W. Seely, New York city, July 1.

This patent is obtained for an improvement on a steam boiler, or evaporator, patented to the said Seely, and Dudley Marvin, on the 28th of August, 1840, and noticed in this Journal, at page 264, vol. ii, 3rd series—by a reference to which notice, the nature of the improvement, as embraced in the following claim, will be readily understood.

Claim.—"What I claim, and desire to secure by letters patent, is, first, the manner of forming the stay bolts in the respective cells, by means of cores, sustained upon a grating of iron, constructed in the manner set forth; said cores having holes bored through them whereever stay bolts are required to cross the cells; the respective parts being arranged in the manner, and for the purpose, [to give sufficient strength to resist the force of high steam,] set forth. And, secondly, I claim the sustaining of the body of the boiler, by means of iron pieces, crossing from side to side, and bolted through the plates forming the upper part of the division between the cells, as above described. I also claim the use of such bridge pieces, in the same manner, and for the same purpose, whether the body of said boiler be formed of cast iron, in one entire piece, or of sheet metal, by riveting the same together in the ususl way."

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5. For an improvement in the *Canal Lock;* Robert English, Lagro, Wabash county, Indiana, July 1.

The patentee calls this "the air and water-acting sympathetic canal lock gate."

At the upper end of the lock, which is the subject of this patent, there is to be an air-tight chamber, provided with what the patentee calls "sympathetic gates," which are hinged to the lock in such a manner as to shut one upon the other, the lowermost being provided with an air-tight float. Below these two gates there are two valves, one of which communicates with the water in the upper chamber of the lock, and the other with a culvert leading to a lower level. When the first named valve is opened, the chamber below the gates is filled with water, which, acting on the float, forces up the gates, and thus closes the lock; and when this valve is closed, and that leading to the culvert opened, the water running out of the chamber to a lower level, leaves a partial vacuum below the gates, which are consequently forced down by the pressure of the atmosphere, aided by their own gravity; a communication is thus opened between the upper and lower levels. Where the water discharges from the upper to the lower level, there is a breakwater attached by hinges to the lock, to prevent the water from rushing too suddenly on to the boat in the lower lock.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the vertically moving gates and air-float, in combination with the chamber, trunks, or culverts, and valves, as a substitute for the common horizontally moving gates—said gates being opened and closed by the combined action of air and water, in the manner set forth, or any other substantially the same. I also claim, in combination with the foregoing, the self-acting breakwater, as described."

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6. For an improvement in the mode of *Fastening Scythes to Snaths;* Silas Lamson, Shelburn Falls, Berkshire county, Massachusetts, July 1.

The first item claimed is a mode of securing the blade to the snath, by means of a metallic saddle, fitted to the lower end of the snath, which saddle receives a shank at the heel of the blade, in combination with the mode of securing the two plates together, either by means of two cam bolts, which pass through slots in the saddle, and which, when turned, secure the shank, or by a spring-catch, which catches in a notch made for that purpose, in that part of the shank which passes through, and extends beyond, the saddle. The second item of the claim is to another mode of securing the blade to the snath, by slitting the heel end of the blade, and turning one part at right angles thereto, and "securing these portions to the snath by screws, one of which has a large flat head to lap over the blade and over the shank, which is placed in an oblong mortise in the turned-up end of the blade, to allow of its being regulated." The third item is also for securing the blade to the snath, by "rendering the heel end of the blade concave, to fit the convex end of the snath, and turning a portion over the back of the snath, and a portion at right angles against the front of it, and securing the blade by screw-bolts, placed in oblong slots, by which the blade can be set at pleasure, as described." The fourth item is for accomplishing the same end by simply passing the bolts, by which the whole is secured, through oblong slots in the heel of the blade, by which it is said that "the blade can be adjusted easily, without removing the screws from the snath, by simply loosening them, and adjusting the blade on the shanks by means of the oblong slots." The fifth item is for securing the nibs to the snath "by forming the two ends of the bar which surrounds the snath into a shank, and perforating the same with oblong apertures, to admit wedges, or keys, which pass through the nib and said apertures, for drawing the snath home to the nib." The sixth item is for effecting the object named in the fifth section, by the combination of a square snath, a saddle at the end of the nib, which rests on one of the angles of the snath, and a bolt, which passes through the whole.

7. For improvements in the combined *Cooking and Air-heating Stove;* Alex. F. Bean, Woodstock, Windsor county, Vermont, July 8.

The claim under this patent is so full, that it needs no additional explanation.

Claim.—"I claim the manner of constructing the swinging hearth, so that the two sections thereof may both be turned entirely back, under and behind the back plate of the stone, and so that each section of it shall have on it a plate, or piece, so formed that when in place, these two pieces will cover, and entirely close, the opening situated beneath and between the vertical grate bars, and leading into the fire chamber; by which device, when the vertical grate bars are also closed, the fire chamber will become that of a close stove, and must receive its supply of air from without the room, in the manner set forth. I claim the mode in which I have combined a tin reflector with my stove, by hinging the same, or causing it to work upon joint pins, in such manner as that it may be turned up, and will, in combination with the sunk hearth, entirely inclose the opening in front of the stove, and that when turned down it will pass beneath the sunk hearth, and be entirely out of the way. I claim the manner of constructing the vertical grate bars in front of the fire, so that they shall consist of flat plates, or slots, hung upon pivots, and be capable of being simultaneously and entirely closed by bringing them into the same plane with each other, in the manner set forth. I claim the placing of the hinged grated piece so that it may be turned up to inclose in part the space, when necessary, and thus to prevent the falling of coals from the fire chamber; and which grated piece may be turned down, so as to be received within the sunken hearth. I claim the constructing of the grate below the fire, and which supports the fuel in the fire chamber, so that it may be raised up and throw the fuel upon the dead plate below it, for the purpose of being covered, to preserve it in a state of ignition. I claim the manner of arranging the parts concerned in supplying air to the fuel, when the front of the stove is inclosed; said arrangement consisting of the tube, or pipe, the air tube, extending along the lower and hind part of the chamber of combustion, and the device by which it is governed at one end by a sliding shutter; the whole being combined and operating substantially as set forth. I claim the manner of constructing and combining the respective parts of the air-heating apparatus, as set forth; the said apparatus consisting mainly of two cylinders with a space between them, inclosing within them a spiral flue, for the passage of heated air from the fire, through which flue pass a number of vertical air tubes, which are supplied with cold air from without the apparatus, as is also the space between the two inclosed cylinders—the same operating by an arrangement of parts such as is made known; there being in the centre of said air-heater a descending flue, for conducting the smoke, &c., to the exit pipe, and an arrangement, such as herein set forth, for allowing the heated air from the fire to pass directly to the exit pipe, without entering the spiral flue. I claim the manner of constructing the oven above the air-heater, as set forth, so that the heated air may be passed back and forth through it when baking is to be effected, or may be made to pass directly up into distribution tubes without entering the oven; this being effected by an arrangement of parts substantially as set forth."

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8. For an improvement in the Endless Chain *Horse Power*, for driving Machinery; William C. Wheeler and Alonzo Wheeler, Columbia, Chatham county, New York, July 8.

The lower edge of the links of the chains, which receive the boards that form the endless floor for the horse, or horses, to tread on, are provided with cogs that take into pinions on a shaft placed across the frame of the machine, to communicate motion to a thrashing, or other machine to be driven.

Claim.—"We are aware that endless chains for horse powers have been invented with plates joined together, and having cogs projecting from their under side, to act on a pinion, and, therefore, we do not claim this as our invention; but what we do claim, and desire to secure by letters patent, is providing the lower edge of the links of the chain, to which the endless flooring is attached, with cogs, to work into pinions, as described."

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9. For a machine for *Cutting Dovetails and Tenons;* Thomas J. Wells, city of New York, July 8.

The construction of this machine exhibits much mechanical skill. The cutters are attached to the periphery of a wheel on the end of a mandrel, and the wood to be tenoned is put on to a second mandrel, parallel to the first, the two being made to turn in the same direction, and with equal velocities. If the tenon is to be of four sides, four cutters are so arranged as to divide the periphery of the cutter wheel into four equal parts; and if the tenon is to be cut on two sides only, then two cutters are employed, and placed opposite to each other. As the cutters revolve they gradually approach the axis of the second mandrel, on which the wood is placed, until they reach a line passing through the axis of the two mandrels, and then they gradually recede from it. Although by means of drawings and diagrams the action of this apparatus might be rendered perfectly clear, it would not be easily understood from mere verbal description, and we shall not therefore attempt it.

Claim.—"The invention claimed, and desired to be secured by letters patent, is the before-described mode of cutting tenons, or dovetails, or other forms, by a similar, simultaneous, rotary motion of the circular plane, and substance on which the tenon, dovetail, or other form, is to be made; the cutting being performed on an increment tangential line to the circumference of the revolving circular plane, whilst the cut made forms the chord line of a segment, on the piece of the circular rail cut away by the revolving cutter.

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10. For an improvement in the *Smut Mill;* Charles D. Childs, York, Livingston county, New York, July 8.

The patentee observes that the "Nature of his invention consists in cleaning damp wheat by throwing a heavy blast of air, with an inclined curved fan, through a column of wheat passing through revolving spikes of cast iron, that all dust and smut may escape through a case, or cylinder, of cast iron rings, having annular openings."

On the same shaft that carries the spikes, mentioned above, a fan is attached below them, said fan consisting of two inclined wings which force a current of wind upwards through the grain as it descends, and blow the chaff out through inclined tubes, or pipes, attached to the case. Below the fan, and on the same shaft with it, is a scouring wheel, with teeth like those of a corn mill. The grain is fed in at the top, and passes down between the revolving spikes, around the fan, and then down to the scourers.

Claim.—"I do not claim the combination of a revolving fan and beaters with a perforated case, or cylinder, as set forth, the fan being arranged below the beaters; nor do I claim the combination of a hopper with a revolving and stationary runner, inclosed in a case, the hopper being arranged above the revolving runner. What I claim is combining those two arrangements, in the manner set forth, the perforated case containing the beaters and fan being placed above that containing the hopper and runners, arranged in the manner described; the revolving runner being placed on the same shaft with the fan and beaters, and the bottom of the case containing the latter provided with spouts for carrying off the dust, and apertures to admit air to the fan, all as set forth."

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11. For an improvement in the *Pump;* C. D. Van Allen, Petersburg, Dinwiddie county, Virginia, July 8.

That part of the pump in which the piston works is made of iron, and the main body of wood, the sections being connected together by screws cut, or cast, on the ends of the iron part, and screwing into the wood; or, by having a metal socket screwed into the wood, and adapted to receive the male screw on the end of the iron section. The lower valve seat is flat, as is also the face of the valve, which is covered with a disk, or ring, of leather; and instead of being hinged in the usual way, it works up and down, in the manner of a puppet valve, guide pieces, or rods, which project from its lower side, serving to direct it properly.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the combining and connecting together of the wooden and metallic parts thereof, by means of cast metal coupling screws, or boxes, screwed into the wood, for the purpose, and in the manner, set forth; and I also claim the manner of constructing the lower valve, the whole being constructed and operating substantially as described."

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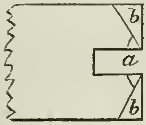
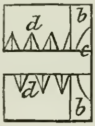
12. For improvements in machinery for *Cutting the Threads on Wood Screws;* Farwell H. Hamilton, Schenectady, New York, July 8.

In this machine there are two spindles, each carrying cutting dies; these spindles are placed side by side, and parallel to each other; each of them carries a pinion that takes into the teeth of a cog wheel placed between them, said cog wheel receives a reciprocating motion from a rack connected with, and moved back and forth by, a crank. The opening and closing of the dies, and the receding and advancing of the spindles, to form the thread, are effected as in some other screw machines. In front of the die end of each spindle there is a feeding wheel, with appropriate jaws for receiving and holding the blanks; an oil tube for supplying oil to the dies whilst cutting, is attached by the middle to a rocking shaft, which is connected with one of the spindles, that as they are turned in opposite directions, and as one is advancing and cutting the thread on a screw, and the other is retreating, the oil tube is shifted to supply the oil to the dies that are in the act of cutting. The dies are made in the manner represented in diagram 1 and 2. They have a nick in the end *a*, of sufficient depth to make the thread deep enough, without having the dies come together. They are then filed away, beveling on each side from the nick, excepting the leaving a lip, *b*, *b*, in which there is a countersink, *c*, to enable it to run readily on to the blank. After these dies are put into their places, a tap is run in, which, instead of cutting threads on them, cuts the teeth, *d*, *d*.

Fig. 1.



2.



Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st. The arrangement of machinery which operates the oil tube, and its combination with the machinery which gives to the spindles an opposite and alternate rotary motion, in the manner, and for the purpose, described. 2d. The method herein described of making the cutting part of the dies with teeth instead of a thread, in combination with the lips, as above described."

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13. For an improvement in the *Smut Machine,* for Cleaning Wheat, &c.; Henry A. Buck, Fredonia, Chautauque county, New York, July 10.

The outer case of this smut machine is cylindrical, the inner surface being fluted, and within this revolves a set of beaters, which are attached, at top and bottom, to an annular ring, the lower one only being attached to the shaft by arms. Within this set of beaters there is a stationary cylinder, or cage, made of square or triangular bars, placed sufficiently far apart to allow chaff and dust to pass between them, but not the grain; its cover, which extends a little above the upper ends of the beaters, is perforated with numerous holes, and above this is a set of wings, attached to a vertical shaft, that passes through the middle of the inner cylinder; the beaters are attached to the shaft by a set of arms below the lower end of the inner cylinder. The grain is fed in at, or near, the top of the machine, and enters the space between the inner and outer cylinders, and in passing to the bottom, where it is discharged, it is cleaned by the beaters, the chaff, dust, &c., being carried through the openings of the inner cylinder, and discharged at the top by an upper current, produced by the centrifugal action of the wings at the top.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the revolving frame, or beaters, with the inner and external cylinder, constructed and operating as above set forth."

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14. For an improvement in the *Revolving Cultivator;* George Whitlock, Crown Point, Essex county, New York, July 10.

The harrow teeth in this cultivator are attached to three rollers, which revolve in a triangular frame, the axes of the rollers forming a triangle. These rollers are all geared together by means of beveled cog wheels. There is a double plough at the forward end of the frame, as in the common triangular harrow, or cultivator.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the side and transverse revolving harrows, operated in the manner set forth, in combination with the frame and plough, as before described."

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15. For improvements in *Bridges;* Earl Trumbull, Little Falls, Herkimer county, New York, July 10.

This bridge, as described, is to be constructed of iron. It consists of arched truss frames, made in sections, the end of each section having a half post, and this, when united and tied to the half post of the next section, forms an entire post. These sections are farther sustained and connected together by suspension rods, which run from the upper part of one end section to the other, passing under the bottom of the middle section; and by tie rods that run from end to end along the lower line of the truss. The truss frames are connected together by transverse cast iron beams, or sills, on which the floor is laid, formed of a bottom and top plate connected together by diagonal braces, all cast together. In addition to these, the trusses are farther connected by diagonal tie rods, running from section to section, under the floor.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the suspension rods with the truss frames, made in sections, for the purpose and in the manner specified, and in combination with these, thus combined, I also claim the tie rods, as specified. I also claim the particular construction of the cast iron beams, or sills, by uniting together, in casting, the two plates, upper and lower, as described, with the diagonal bracing, as described."

16. For an improvement in the *Wrench;* James Brett, Newburgh, Orange county, New York, July 10.

The sliding jaw, in this wrench, is provided with teeth fitting into corresponding teeth on the upper edge of the bar, and these prevent the jaw from sliding when the parts are held by a wedge which passes through a mortise in the jaw, and bears on the back edge of the bar.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the teeth on the slide, and their combination and connection with the teeth on the bar. I make no claim, whatever, as the inventor of any other part of the wrench."

17. For an improvement in *Locks for Doors, Chests, &c.;* David Evans, Philadelphia, Pennsylvania, July 10.

"The main feature of this invention consists in the providing of a sliding plate, or cover, by which the key hole is to be closed spontaneously on withdrawing the key, and that in such manner as that the key cannot be made to enter the lock until a catch is raised, and a shaft, or handle, turned, by which the plate is made to slide back to the required distance, when the key may be readily inserted. The part by which this catch is raised, and the handle, or shaft, by the revolution of which the covering plate may be made to slide back, may be varied in numerous ways, and must, in fact, be so varied, in order to adapt the invention to the kind of lock employed, and the article to which it is appended. The sliding plate is case-hardened, where it covers the key hole, so that it cannot be drilled, or cut, by any tool."

Claim.—"What I claim therein, and desire to secure by letters patent, is the causing of a metallic plate to slide over and to close the key hole of a lock, in such manner as not to require any care on the part of the person withdrawing the key, so that a key cannot be inserted until said plate is removed; which removal is to be effected by the aid of two concurring motions, by one of which the plate is unlatched, or released, from a catch, and by the other of which it is made to slide, so as to cause a hole in said sliding plate to coincide with the key hole; the respective parts by which these effects are produced, being constructed, arranged, and operating substantially as herein set forth."

18. For improvements in *Piano Fortes;* Lemuel Gilbert, Boston, Massachusetts, July 10.

The claim is to the "constructing the centre block of the hammer with an arm projecting below its centre of motion, and having a regulating button attached thereto." To making the "jack without a regulating button, so that the fly may abut upon, or against, a long strip of cloth, or wash leather, applied to the rear of the top of the same, thereby in a high degree preventing noise in the action of the same, in combination with a hammer having its centre block constructed with the arm and regulating button." Also to a "jack having a regulating button in combination with a hammer, whose centre block is constructed as described." And finally, to "loading the centre block of the hammer."

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19. For improvements in the *Argand Burner,* for burning Camphine and other chemical oils; Stephen J. Gold, Cornwall, Litchfield county, Connecticut, July 16.

The claim is to the "mode of compressing the wick by means of two thin, movable, metallic, cylindrical tubes, combined with the wick case, the two cylinders, or wick tubes, with the wick compressed between them being inserted into the annular space between the two cylinders of the wick case, with a portion of said wick tubes extending above the wick case, to allow of their being kept cool by the draught; and also for combining with the outer cylinder of the burner and the rod supporting the button, a movable cylinder, or screw, disconnected from the rod, but having a button plate which, when the cylinder is turned up, presses against the rod and elevates it; and allows it, when turned down, to return either by its own weight, or by the action of a spring."

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20. For an improvement in the *Process of Vinous Fermentation;* Charles O. Wolpers, Cincinnati, Hamilton county, Ohio, July 16.

We are informed by the patentee, in his specification, that the "Nature of his invention consists of the method of conducting vinous fermentation in close vessels, by combining a series of close vessels with one or more open or shut vessels, as the case may require, containing a solution to be charged with carbonic acid gas."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method, or process, of conducting vinous fermentation in close vessels, by fermenting the beer, or wash, in a series of close vessels, or vats, combined and operating in the manner set forth."

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21. For an improvement in the *Tobacco Press;* Elliott Richardson, West River, Anne Arundel county, Maryland, July 16.

This patent is for an improvement in the vertical screw press, to be worked by horse power, and is a modification of that kind of press in which the nut, through which the screw passes, turns, instead of the screw. The lower part of this nut is made with a flanch, and its upper part is poligonal, to receive and be secured to the horse sweep. The upper cross head of the press is provided with a plate of metal, through a hole in which the screw passes, and on this plate the revolving nut rests; a second plate is passed over the nut, embracing the flanch thereon, and is bolted to the head beam; in this manner the nut is held down, whilst it is left at liberty to revolve. To the head beam there is attached a cross piece, at right angles to it, from which descend two rods, or studs, one on each side of the hogshead, for the "purpose of steadying" and keeping the hogshead and the pressing screw in a vertical position.

Claim.—"I do not claim as of my invention, the actuating of the screw by the revolving of the nut. But I do claim the manner of forming and combining the nut and metallic box, as set forth, in conjunction with the combining them with the head block, by means of which arrangement the press can be conveniently worked by horse power, whilst the head block of wood is left of such strength as to render it perfectly efficient. I claim, also, in combination with the foregoing arrangement, the employment of the studs affixed in the manner described, for the purpose of steadying and keeping the hogshead and screw in a vertical position."

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22. For a combined percussion and reaction *Water Wheel;* Clark Lewis, Syracuse, New York, July 16.

This wheel is surrounded by a "stationary rim," with eight or more apertures at equal distances apart, through which the water is admitted to the wheel. The inner sheathing of the wheel is conical, and the upper and lower rims are of the same diameter, the inner edge of the upper one being united to the conical sheathing, by which an annular opening is formed at the bottom, between the lower edge of the conical sheathing and the inner edge of the lower rim, for the discharge of the water. That face of the buckets against which the water impinges when it enters the wheel, is radial, and is then curved until it reaches the lower edge of the conical sheathing, so as to form a reacting bucket.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I construct the buckets of my wheel, as set forth, so as to discharge at" (should be towards) "the centre, and produce a reaction, as well as a percussion effect, in combination with the stationary rim, having apertures in it for admitting the water to the wheel, the whole being constructed substantially in the manner, and for the purpose, above described."

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23. For improvements in the *Smut Machine* for Cleaning Wheat and other small grain; Thomas R. Bailey and Ezra Rich, the former of Weybridge, and the latter of Shoreham, Addison county, Vermont, July 16.

The patentees say:—"Our machine consists of two hollow, conical frustums, or cylinders, of cast iron, the outermost of which is stationary, whilst that within it is, when used for cleaning grain, to be made to revolve with great rapidity; each of these frustums, or cylinders, is to consist of strips, or staves, of cast iron, which are to be confined in place by means of suitable grooves, or depressions, cast on the heads, or rims, by which the ends of the staves of each frustum, or cylinder, are to be received and held together. Between each of the staves, or strips, which form the peripheries of each of the cones, or cylinders, there is to be a slot, or opening, extending along its whole length, for the passage of air."

"What we claim as constituting our invention, and desire to secure by letters patent, is the arranging of the staves which constitute the outer case, or stationary frustum, or cylinder, so that they shall overlap each other to a small distance, and at the same time leaving a space between each contiguous stave for the passage of air, smut, and other impurities from the grain, whilst the grain itself is prevented from passing through. We also claim the manner of constructing the inner revolving frustum, or cylinder, by forming the same of cast iron staves, so combined as to overlap each other, and to leave a space of a fourth of an inch, more or less, between them, for the passage of air, to be supplied from without the apartment; the whole being arranged and combined together substantially in the manner set forth."

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24. For an improvement in the *Reaction Water Wheel;* Nathaniel F. Hodges, Carning, Steuben county, New York, July 16.

"The distinguishing features of this wheel are, first, that its general form is that of a segment of a hollow sphere, each of the individual buckets, which by their combination, give to it this form, being also segments of hollow spheres; and secondly, in causing the openings between these buckets, through which the discharge of water takes place, to extend from the periphery of the wheel to the eye, or opening, through which the shaft passes. There is not, therefore, on the face of this wheel, any back, or bottom, plate, or imperforated portion upon which the water presses without having a tendency to turn the wheel." So says the inventor.

"What I claim therein, and desire to secure by letters patent, is the so constructing the wheel, as that each of its buckets shall constitute a segment of a hollow sphere, and that these shall be so arranged and combined with each as that the openings for the discharge of water shall extend from the outer rim to the eye, or shaft, and the wheel itself, thus constructed and combined, shall constitute a segment of a hollow sphere, as set forth."

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25. For improvements in the *Portable Saw Mill,* for Sawing Timber with the Circular Saw; George Page, Baltimore, Maryland, July 16.

In this mill, the shaft of the circular saw has its bearings longer than the width of the boxes in which they run, so as to allow it to have free end play, and the saw is embraced on each side, just back of the teeth, between two friction rollers, which serve to guide it. Each of the guide rollers is attached to a separate plate, the two plates being placed one above the other, and provided with a slot for securing and setting the rollers. The carriage is made in sections for the convenience of transportation, the different sections being united by means of a rack rail at the bottom.

Claim.—"What I claim as my invention, &c., is the manner of affixing the circular saw, by allowing end play to its shaft, in combination with the means of guiding it by friction rollers embracing it near to its periphery, so as to leave its centre entirely unchecked laterally. I do not claim the use of friction rollers, embracing and guiding the edge of a circular saw, these having been previously used for that purpose, but I limit my claim to their use in combination with a saw having free lateral play at its centre. I claim the particular manner in which I have applied said friction rollers, by attaching the pins, or pivots, upon which they are sustained and revolve, to two plates of metal placed upon each other, and both held by the same set of screws, as set forth. I claim the manner of forming a long carriage from two short sections, by coupling, or uniting, said sections, by means of the rack rail only, as described."

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26. For an improvement in the *Machine for Cleansing Wool and Cotton;* William W. Calvert and Alanson Crane, Chelmsford, Middlesex county, Massachusetts, July 16.

This "improvement in the machine for separating burs, seeds, and other foreign substances, consists in our substituting for the knife, or guard, which has ordinarily been employed to arrest and separate the burs, seeds, &c., a revolving roller, which is fluted, or channeled, from end to end, or which is otherwise so formed and constructed as to cause a number of projecting edges to strike in rapid succession against the foreign matter which is to be separated from the fibres, and thus to clear, or pick, such matter out by an operation analagous to that of picking it out by the finger nail."

Claim.—"What we claim therein as our invention, and desire to secure by letters patent, is the employment of a revolving, fluted, or channeled, cylinder, or of any analogous revolving apparatus, which will present in rapid succession a number of picking, or clearing, edges, to operate upon the burs or other foreign matter contained in wool or cotton, in combination with the fine comb cylinder and the picker cylinder, or other apparatus analogous thereto, by which wool is carried up, and presented to the action of the revolving, fluted, or channeled cylinder, as described."

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27. For a method of making *Indelible Ink;* Thomas J. Spear, New Orleans, Louisiana, July 16.

The following is the whole of the specification, viz:—"Take three drachms of the least bruised India ink, and four ounces of boiling solution of caustic soda, and mix these together, and shake the mixture well for about ten minutes, when the indelible ink is produced. What I claim as my invention and discovery, and which I desire to secure by letters patent, is the before described indelible ink."

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28. For an improvement in the *Shoemakers' Paring Knife;* Isaac S. Pendergast, Barnstead, Belknap county, New Hampshire, July 16.

The patentee says:—"I do not claim to be the first to have constructed knives for paring the soles of shoes with fenders, or guides, to prevent the knife from cutting the upper leather, but what I do claim is the combining with the blade of the knife, a shield, or cap, in the manner described, viz: by forming the cap with a straight shank, flat upon one side, that it may rest upon the blade, and inserting the end of the same into the socket by the side of the blade, as described; by means of which arrangement, I am enabled to give greater strength to the blade, and at the same time protect the upper leather from being injured."

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29. For an improved mode of *Heating Water for Leaching Ashes;* Joseph H. Ward, Randolph, Portage county, Ohio, July 16.

We are informed by the patentee, that the "nature of his invention consists in providing a vessel, in which ley is boiled, with a cover, or lid, sufficiently tight to prevent the escape of steam, except through a tube which conducts it into the water which is to be heated, for the purpose of leaching ashes.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the leach tub and reservoir of hot water with the boiler in which the ley is evaporated, by means of a tube, or tubes, for conducting steam from the boiler to the reservoir, for heating the water in the same, the whole being constructed in the manner, and for the purpose, set forth."

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30. For an improved machine for *Cutting and Gathering Flax and Hemp;* Richard M. Cooch, Lambertsville, Hunterdon county, New Jersey, July 16.

This machine is, in its general construction, like that for which a patent was granted to William Britain and John Silvers, on the 25th of November, 1838, and noticed in this Journal, vol. xxiv of the second series, page 323, to which the reader is referred for a general description of its construction; the improved machine differs essentially from the former in its being made to cut the flax, or hemp, close to the ground, instead of being a "machine for pulling flax and hemp." The flax, or hemp, is caught between a horizontal drum and a system of endless belts, there being a projecting arm, or gathering piece, which conducts it to the drum, and whilst it is held and carried forward by the drum and belts, it is cut off, close to the ground, by a revolving knife, which is operated by the system of belts employed to catch and hold the hemp, &c.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combining of the revolving knife with the drum, the gathering piece, and the endless bands, as herein described, so as to convert the said machine from one for pulling flax and hemp, into one for cutting and delivering the same, the whole being constructed and operating substantially as set forth."

31. For improvements in the machine for *Cutting Crackers;* Charles P. Forbes, Baltimore, Maryland, July 16.

In this machine, the dough, after being rolled, passes on to an endless belt, in the usual way, but instead of pressing the cutters down on to the belt, on which the dough is placed, the belt is pressed up against the cutters, which are arranged above it, there being a curved plate placed under the belt for this purpose. This plate, the curved surface of which is a segment of a cylinder, is hung by two cords passing over pullies, and provided with weights, to press it up against the cutters. When the dough is passed under the cutters, the attendant rolls the curved surface of the plate against the under surface of the belt, by which operation the crackers are cut.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the edge of the outside cutters project beyond the edge of the inside cutters, and have the points of the dockers on a level with the edge of the outside cutters, as herein described, so as to dock and cut the outside edge through, whilst the inner cutters do not cut sufficiently far to separate the crackers. I also claim the method, herein described, of cutting the dough, by having the cutters and dockers permanent, and pressing the upper part of the belt, or apron, on which the dough is placed, up against the cutters and dockers, by means of a curved plate attached to a lever, drawn up by weights, and guided by hand, in the manner described."

32. For an improvement in the machine for *Cutting Sheet Tin, or other Sheet Metal, and Glass;* Andrew Tracy, Poughkeepsie, Dutchess county, New York, July 17.

This machine differs very little from other machines for the same purpose, which have been patented. The plate of metal to be operated on is held between two plates, each of which is attached to a rotating spindle, the uppermost being provided with a spring, which bears it up when not acted upon by an eccentric lever, by which it is forced down, to hold the sheet of metal. The spindle of the upper plate is provided with a lever, with which to turn it when desired; it is furnished with a pall, which catches into the teeth of a ratchet wheel attached to the spindle. In operating with this machine, either the holding plates, with the sheet metal, may be made to turn, or the shears may be carried around the holding plate, at pleasure.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is, first, attaching the upper rotary shear to a hinged piece, regulated by a thumb screw, for the purpose, and in the manner, specified. Second, attaching the stock of the shears to a lever revolving around the centre of the holding plates; and third, the combination of the lever and ratchet with the upper holding plate, for turning the metal, or glass, as herein described."

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33. For an improvement in the form of *Spikes and Nails;* William Ballard, New York city, July 17.

This improvement in spikes, or nails, consists in making offsets, or indentations, on the opposite sides of, or around, their shank, which offsets, or indentations, are to be in such form as not to cut, or tear, the wood, as is the case with those which have projecting points, or serrated edges, formed upon them, by means of a cold chisel, or by some analogous means, in the manner which has been frequently resorted to. These spikes are also provided with a secondary head below the main head, but of less size, over which the wood will close, and thus make it adhere more firmly.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is the forming of spikes, or nails, with offsets, or indentations, which offsets, are without sharp, or cutting, edges, so that when driven they shall not injure the wood, but shall hold firmly, by the collapsing of the wood upon them. I also claim the forming of the secondary head, for the purpose, and in the manner, set forth."

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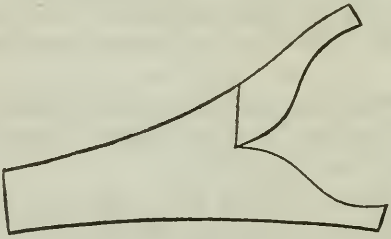
34. For an improvement in the method of *Cutting Leather for Making Horse Collars;* Thomas Parkinson, Sparta, Livingston county, New York, July 17.



Claim.—"What I claim as new, and desire to secure by letters patent, is the cutting of the leather which is to constitute the covering of the collar, to a pattern substantially in the manner of the two pieces represented in the accompanying drawing, preserving in all variations of size, the relative proportions of the respective parts, as made known."

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35. For an improvement in the machine for *Working and Pressing Butter;* Titus D. Gail, Eden, Erie county, New York, July 20.

This machine constitutes an improvement which has been added to a patent granted on the 10th of October, 1840; the original patent is noticed in vol. ii of the third series, page 392. Instead of the permanent table, pierced with two holes, and provided with pistons working from below, and having a trough above it, as in the original machine, the table is made to slide under the trough, and is provided with several sets of holes and pistons, to receive and work the butter.

Claim.—"What I claim as constituting my improvement upon the machine originally patented by me, is the employment of the sliding table and the stationary trough, constructed and operating in the manner set forth, in lieu of the apparatus employed for the same purpose in the original machine, by which the instrument is much simplified in its construction, and rendered more convenient in use."

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36. For an improvement in the *Ring Groove Spinner;* David Hunter, Laurel Factory, Prince George county, Maryland, July 23.

In this improved spinner ring, with the hooks, or wires, through which the thread passes, and which carry it, is attached to the lower ends of the flyers, and works either in a circular concave, or between four grooved rollers, instead of working independently of flyers, as heretofore.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is the construction of the ring spinner, when attached to the flyer rods, in combination with the circular concave seat, or rollers, in which it turns, as described."

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37. For improvements in the *Sofa Bedstead;* James M. Meschutt, city of New York, July 23.

This sofa is changed into a bedstead by stretching a sacking across from the upper part of the back to a rail in front, which is attached to two pieces hinged to the upper part of the two front pillars, and folding on to them, and these, when closed down, form the ornamental part, or facing, of the pillars. There is a brace hinged to the front rail, for the purpose of stretching the sacking when the frame is thrown up.

Claim.—"I am aware that a patent has been granted for a sofa bedstead, on the principle of the cot bedstead, in which a frame, hinged to the front of the sofa, is employed, and I do not therefore simply claim the employment of a frame, hinged to the front of the sofa; but what I do claim as my invention, and desire to secure by letters patent, is the adaptation of an extra frame to the front of the common sofa, connected by hinges to the tops of the pillars, and supported at the extremities by the legs, in combination with the brace which slides through the front rail when the extra frame and legs fold down against the pillars and front rail of the sofa, for the purpose, and in the manner, specified."

38. For a Compound to be used in the Cure of *Syphilis, &c.;* Silas Thurman, Lincoln, Kentucky, July 23.

The compound which is the subject of this patent is to effect the cure of syphilis, gonnerhœa, buboes, gleet, leuchorhea, &c. The recipe is as follows: "Take 12 lbs. green poke root, which is to be cut small, and boiled in 16 gallons, [water we suppose,] until reduced to half a gallon; let this cool, and press and strain it. This constitutes the first portion of the tea. For the second, take 7 oz. dry sarsaparilla, put half of this into 3 pints of whiskey, and let it remain until the strength is extracted. Then take 12 oz. cedar tops; the half portion of sarsaparilla; rattle weed, 4 oz. of the root; and half a pound of sumach, and put them into 16 galls. of water, and boil down to half a gallon. Add this to the first tea, together with the extract of sarsaparilla in whiskey, and it is fit for use. For syphilis, take 2½ drachms of sulphur, night and morning; take epsom salts, also, to keep the bowels open, and every morning, noon, and night, take 3 oz. of the tea. Get bled every few days, until the blood becomes of a pure and natural color." "In any common case of all the above described diseases, ten or twelve days will effect a perfect cure, unless calomel has been taken, then it will require longer." "Calomel is prohibited in all cases; but in cases of syphilis, the ulcers must be greased every time after washing, with red precipitate; [ointment, probably.]

"What I claim as my discovery, and desire to secure by letters patent, is the compound formed by the above described ingredients and process; using for that purpose a smaller or greater quantity of the same ingredients, to make a smaller or greater quantity of the compound."

As may well be supposed from the general texture of the foregoing description, the original specification displays an abundant lack of knowledge upon the subject to which it refers, and we really think the application was one which ought not to have received the sanction of the seal of the patent office. The compound is analogous to such as have been frequently made, and offers no substantial novelty, whilst the effect claimed to be produced by it, will not be attained, and proceeds from entire ignorance of medical science. It is, therefore, like most patented medicines, a fraud upon the public.

39. For an improved *Measure for Liquids;* John S. Tough, Baltimore, Maryland, July 23.

The lower part of the measure, above referred to, is to be funnel shaped, and provided with a valve, or spigot, which, when opened, permits the liquor to escape into any vessel, without the trouble of pouring out, and using a separate funnel. The instrument is divided into sections of different diameters, each diameter forming a measure of different capacity.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is combining with the ordinary measure for liquids, a funnel governed by a spigot, or valve, for allowing the liquid to be let off, as set forth; and also the combining two or more of the common measures for liquids in one piece."

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40. For an improvement in the *Cooking Stove*, called the "Franklin Economy Cooking Stove;" Mathew Stewart, Jr., Philadelphia, Pennsylvania, July 23.

This stove contains a reflecting oven, the form of which is that of two truncated pyramids, united at their bases, the inclined surfaces being intended to concentrate the heat in the centre. Each end of the oven is attached to a semi-cylindrical furnace, the chords of which are towards the centre of the oven. Over the furnaces there are openings for smoke pipes, and for cooking utensils.

Claim.—"No claim is made to the combination of an oven with a furnace, or heater, at each end of it; but what I do claim, and desire to secure by letters patent, is the peculiar construction of the heat reflecting oven, as described, in combination with the two semi-circular stoves, with funnel-shaped caps, for saving fuel and cooking expeditiously, as before described."

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41. For an improvement in the *Mill for Manufacturing Flour;* Andrew D. Worman, Fredericktown, Maryland, July 23.

The middlings, which are to be mixed with the fresh ground chop from the burs, are put into a hopper prepared for that purpose, which hopper is so placed that the middlings contained in it shall be conducted from it into the spout, or trough, in which the elevators are carrying up the fresh ground wheat to the hopper boy; and to the hopper containing the middlings is appended a shoe and a sliding shutter, in the ordinary way, for the purpose of regulating the feed from them. In this way the middlings will be perfectly and equally distributed and mixed among the fresh ground chop, and will be, in this state, carried through the respective processes to which the flour is subjected, until it is ready to be packed.

Claim.—"What I claim as constituting my invention, and desire to secure by letters patent, is an improvement in the process of manufacturing flour, by conducting the middlings into the trough of the elevators, by means of a spout leading into it, and governing the feed by a hopper and shoe constructed in the usual manner, so that said middlings shall become equally and intimately mixed with the flour, and will, in the subsequent steps of the process, be entirely, or nearly so, brought into the state of superfine flour."

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42. For an improvement in the *Cotton Gin;* Lewis G. Sturdevant, Delaware, Delaware county, Ohio, July 23.

In the cotton gin which is the subject of this patent, instead of the cylinder of saws ordinarily employed, there is a cylinder, the surface of which is covered with fine teeth, and over this there is another cylinder, provided with beaters, consisting of strips of iron placed edgewise, and extending from end to end thereof. As these revolve, the beaters on the upper, are brought nearly into contact with the teeth on the lower, cylinder, the space between them being merely such as will allow the fibres of cotton to pass, whilst the seeds are beaten back, and separated from the fibres by the action of the beaters. The cotton is to be removed from the teeth by a brush cylinder, in the usual manner.

Claim.—"What I claim as new, and desire to secure by letters patent, is the separating the cotton from the seed, by the combined operation of a cylinder covered with fine teeth, formed in the manner of saw, or rasp, teeth, and of a beater cylinder, arranged and operating as herein set forth; the other parts of the gin being constructed in the usual manner, I also claim the forming of the toothed cylinder, by winding around it a cylindrical coil of wire, prepared and cut with teeth, as described."

43. For an improvement in a Surgical Instrument called the *Speculum Ani;* Joseph T. Pitney, Auburn, Cayuga county, New York, July 23.

That portion of the patented speculum ani which is to enter the rectum, consists of two blades which are convex on their outer, and concave on their inner, surfaces; they are made tapering, or conical, diminishing in size from the handles to their outer ends. The edges of this part are carefully rounded off, and made perfectly smooth. These blades are attached to forceps handles, the two portions standing at an angle of about one hundred and twenty degrees, more or less, with each other; through one of the handles passes a set screw, by which the blades may be more gently opened, and retained in any position.

Claim.—"I hereby declare that I claim, as of my invention, the manner in which I have formed and combined the respective parts; that is to say, I claim the forming of a speculum ani with tapering, or conical, blades, united at their larger ends to forceps handles, standing at a suitable angle with the blades, to admit of the ready inspection of the parts, and furnished with a set screw to regulate the opening of the blades, by which combination and arrangements of its parts, the instrument is rendered more effective, and more convenient in use, than such as have been heretofore made for the same purpose."

44. For an improvement in the *Mill for Granulating Corn, Powder, Bark, &c.;* Increase Wilson, New London, Connecticut, July 23.

The mill which is the subject of this patent, purports to be an improvement on the ordinary cylinder mill. It consists of two cylinders, differing in diameter, and revolving with different velocities. Angular grooves are turned around these cylinders, and upon the projecting angle of each, teeth are formed, and the toothed projections on one of the cylinders, are received within the grooves in the other.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the peculiar manner of arranging the cylinders, so as to have the cutters on each cylinder enter and run in the scores, or spaces, in the other cylinder, as described."

45. For an improvement in the *Smut Machine,* for cleaning Grain; Samuel Bentz, Boonsboro, Washington county, Maryland, July 23.

Within a perforated cylindrical case, armed with beaters on the inside, are two sets of beaters, one within the other, which turn in opposite directions. The axes of these beaters are horizontal. The grain is fed in through an opening at the top, and passes out through an opening at the bottom; and in falling, it is met by a strong horizontal current of air from a fan, which carries off all the lighter matters leaving the grain to fall through an aperture in the lower part of the air trunk, below that in the lower part of the perforated case.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the arrangement of the cylinders of beaters, the one set of beaters revolving within the other set, in contrary directions, in an armed perforated cylindrical case; in combination with the fan, trunk, and gearing; arranged in the manner set forth, for separating smut, white caps, hulls, chaff, and all kinds of impurities, from the several kinds of grain which the machine is adapted to clean."

46. For an improvement in the "*Universal Mill;*" James Bogardus, city of New York, July 29.

The mill upon which this is an improvement was patented by Mr. Bogardus on the 18th of January, 1832, and is noticed in this Journal vol x, 2nd series, page 34. By reference to this notice its general construction will be ascertained, and the subjoined claim designates the improvement.

Claim.—"What I claim as my invention, and desire to secure by letters patent, in combination with the manner of placing the upper stone, or plate, a little off the centre of the lower stone, or plate, (which I have already patented,) is, firstly, the construction and use of one or more circular grooves in either one, or in both, of the stones, or plates, as before described, or in any other manner substantially the same, to accelerate the feeding, and to produce, besides the hulling or grinding action, a cutting action like that of shears. Secondly, the combination of the upper shaft with the upper stone, or plate, in the manner hereinbefore described, or in any other manner substantially the same, to operate, in combination with other parts described, for the purposes of hulling seeds, grinding drugs, paints, dye stuffs, bread stuffs, &c.; or cutting fruits, &c."

47. For an improvement in the form of the *Harpoon for taking Whales;* William Carsleys, New Bedford, Bristol county, Massachusetts, July 29.

The flukes, or barbs, of the harpoon above designated, are to be so twisted as that after being thrown, it shall, on entering the body of the animal, cut its way in an oblique or spiral direction.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the twisted form of the barbs, or flukes, of the harpoon."

48. For an improvement in *Self-setting Saw Mill Dogs;* Linus Yale, Newport, Herkimer county, New York, July 29.

The bale of the improved dog is jointed to the upper part of a sliding nut, which is made in two parts, an upper and a lower plate, bolted together. These two plates at their junction embrace two ways on which they slide. The screw that passes through this nut has on its outer end, beyond the end of the head block, a ratchet wheel permanently attached to it, and outside of this a hand lever, with a hand to catch into the notches of the ratchet wheel, for the purpose of turning the screw to set the log; and outside of the said hand lever, and turning freely on the stem of the screw, is an elbow-lever, one arm of which, by means of a pin projecting from its side, acts upon the hand lever, and thus upon the screw and dog, and the other strikes against a pin attached to the floor, as the carriage reaches the end of its course, by which the whole is put in motion, and the log set for the next cut.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is not the principle of the screw, hand lever, notched wheel, or iron band, as others of a different form have been used; but what I do claim is, first, the nut in combination with the wrought iron dog, as herein described. Second, the self-setting lever in combination with the hand lever, notched wheel, and screw, for the purpose, and in the manner, specified."

49. For a method of making *Knobs for Doors, Locks, &c.;* John G. Hotchkiss, John A. Davenport and John W. Quincy, city of New York, July 29.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manufacturing of knobs of potters' clay, or any kind of clay used in pottery, and shaped and finished by moulding, turning, burning, and glazing; and also of porcelain."

50. For an improvement in the machine for *Cutting Screws on the Rails of Bedsteads;* Joel Thompson, Cynthiana, Harrison county, Kentucky, July 29.

The machine above named is a modification of one in general use, for cutting the screws on the ends of bedstead rails, and consists of a stock attached to a standard, which has the usual V cutters for cutting the threads; and forward of this there is a guide, consisting of an aperture of sufficient size to receive the body of the rail, so as to insure the cutting of the threads concentric with the body of the rail. In the stock there is a gauge, which fits into a mortise in said stock, and is joined to it, and against this, when dropped down the shoulder of the rail bears before the stock screw, by which the rail is turned, is attached to the rail, so as to insure the cutting of the screw on each end of the rail to the same point. There are two guide apertures, and an equal number of cutters and gauges, one set for a right, and the other for a left, hand screw.

Claim.—"The invention claimed, and desired to be secured by letters patent, consists in the arrangement of the stock in combination with the guide apertures, made of sufficient capacity to receive the body of the rail, and the gauges in said stock in the standard, for determining the true position of the rail in cutting the right and left screws thereon, as set forth."

51. For an improvement in the *Manufacture of Buttons;* Thomas Prosser, Paterson, Passaic county, New Jersey, July 29—anti-dated January 29, 1841.

The buttons which are the subject of this patent are to be formed of clay, or other earthy materials, and metallic oxides, such as are now commonly used by potters in domestic earthenware; they are to be made in metallic moulds, in which the materials are compressed with considerable force.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manufacture above mentioned, consisting of buttons formed of compressed clay, or other earth materials, as set forth."

52. For an improvement in the mode of *Combining Levers and Springs, to sustain the bodies of Wagons and other Carriages;* Elihu Ring, Trumansburg, Tompkins county, New York, July 29. (See Specification.)

53. For an improvement in the manner of constructing and applying the Springs used as *Bumpers and Draught Springs,* in Railroad Cars, &c.; Fowler M. Ray, Cattskill, Greene county, New York, July 29.

The improved springs consist of flat and straight leaves, or plates, of spring steel, there being two or more leaves, either of equal or of unequal length, and so placed as to stand across the frame of the car, from side to side, where they are received in pockets, the sides of which, towards the springs, are so curved as that under an increased pressure the points of bearing are gradually approaching, and thus increasing the rigidity of the spring.

Claim.—"What I claim as new, and desire to secure by letters patent, is the combining of springs composed of straight leaves, or plates, of steel, in the manner set forth, with pockets curved at their sides, in such a manner as that the flexure of said springs shall cause them to diminish, progressively, in their effective length, and consequently to increase in their power of resistance. I claim, in combination with said springs and pockets, so constructed and arranged, the employment of the curved check pieces, to co-operate with the curved pockets when the leaves are all of one length. I claim, also, the substitution for said check pieces, and the combining with the long leaves, which extend to the bottom of the pockets, such number of shorter leaves as may be found necessary, and in the manner herein described."

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54. For an improvement in the *Portable Saw Mill;* James C. Mayo, Columbia, Fluvanna county, Virginia, July 29.

In this improved mill the log is stationary, and the frame in which the saw works moves up thereto, it being made to slide forward for that purpose. A rack attached to the movable frame passes over a pinion on the axle of a ratchet wheel, giving motion to it in the same manner that the carriage of the common mill is actuated. The saw, instead of being strained in a saw frame, is attached at its upper end to a block which slides in ways, and at its lower, to a crank which is actuated by a belt that passes around a drum on the shaft of the crank, and also around a drum at each end of the frame.

Claim.—"What I claim as new, and desire to secure by letters patent, is the particular combination and arrangement of the respective parts thereof, as set forth—that is to say, I claim the described manner of combining the saw with the sliding frame; the crank to which the lower end of the saw is attached having its bearings in said sliding frame, and the sliding frame being made to embrace the side pieces, and being otherwise combined, and arranged, and actuated, in the manner set forth. I am aware that a saw has been actuated directly by a crank at its lower end, and that a saw has also been made to move up towards the log by means of a sliding frame; but these have not been used in combination with each other, and I therefore limit my claim to this combination, under the arrangements substantially as above described."

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55. For improvement in *Fire Arms;* Charles Lewis Stanislas Baron Heurteloup, a subject of the King of the French, July 29.

The fire arms which are the subject of this patent are of the percussion kind. The compound employed for priming is contained in a small flattened lead tube; this priming tube is placed within a covered channel made in the under side of the stock, and from this it passes into a channel made in the lock plate, which is, for that purpose, made longer than usual, and attached to the under side of the stock. This plate has a large chamber made in it, in which the explosion of the priming, &c., takes place. The continuous priming is carried forward, at every reloading, by a cog wheel, which is turned by the thumb, the priming being pressed up against the cogs by a flat spring. At each discharge, a piece of this priming is cut off, by a cutter attached to the cock, is carried to the touch hole, and is there exploded, by the hammer.

Claim.—"What I claim, and desire to secure by letters patent, is, first the making of the large plate so as to adapt it to the reception of the mechanism which moves the continuous priming, also making therein the chamber to receive the smoke, or deposit, caused by the ignited powder, in order that it shall not injure the different parts of the lock, which large plate also presents the peculiar characteristics of containing within itself the hole to receive the axis of the cock, the receptacle, or channel, for the priming, the chamber to receive the smoke, and the spitter, all within the same solid piece of metal, so that the distances between the various parts of the machinery herein described, being always fixed and invariable, the action of the parts shall not admit of any variation; all as described. Secondly, the making of a covered channel, for confining the continuous priming between the barrel and the stock, in the stock before the lock, from which it can be drawn towards the touch-hole; and in combination therewith, the priming conducting spring, which presses the priming towards the wheel; the wheel for moving it forward, or backward, and fixing it, all as hereinbefore described. Thirdly, the compressor with two shields which is fastened to the lock, in the mode, and for the purpose, specified."

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56. For an improvement in the mode of *Propelling Ships, Boats, and other Vessels;* Elisha F. Aldrich, city of New York, July 30.

In this improved mode of propelling boats, &c., the wheels are constructed with permanent radial paddles, the ends of which but against the rims of the wheels, so that the principal part of the water against which the paddles act has to pass in between them, through the space between the inner periphery of the rims and the centre, or hub, and is forced out by centrifugal power against the water back of the wheel—thus impelling the boat forward. The wheels constructed in this manner are placed either in hollow trunks, or cases, within the vessel, or in similar cases built outside, and open at the bottom, the wheels projecting below the bottom of the trunks, or cases—or they may, it is said, be placed horizontally, and act on the water at the sides of the vessel.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of propelling ships, boats, and other vessels, by means of wheels that receive water at the centre, or any distance from the centre, and throw it out at the periphery by the action of the centrifugal force, as herein described. I also claim the mode described and set forth of constructing wheels to be applied to vessels for the propulsion of the same, the wheels to revolve vertically or horizontally; and I claim, also, the mode of placing the wheels nearly, or quite, as low as the bottom of the vessel, to revolve within cases attached to the sides of the same, as described."

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57. For an improvement in the machine for *Planting Cotton Seed;* R. S. Thomas, Bennetsville, Marlborough District, South Carolina, July 30.

The bed piece of this machine rests on the ground, and is provided with a piece like a keel forward of the seeding roller, for making the furrow; that portion of the bed piece which is back of the seeding roller is hinged to the forward part, so as to yield in passing over stones, &c. The seeding roller is made with ridges, or points, between the excavations for the seeds, for the purpose of agitating them to insure their falling into the excavations. This roller is carried round by two wheels on its axle, which run on the ground. The hopper rests freely on the seeding roller, that part of its surface which rests on said roller being covered with leather, or other yielding substance.

Claim.—"What I claim as new and desire to secure by letters patent, is the manner of constructing the seeding roller with alternate ridges, or points, and excavations for the reception of the seed to be planted; the ridges, or points, operating as agitators to keep the seed in motion, and cause it to fall into the excavations. I am aware that agitators have been frequently used within a hopper in seeding machines, but these have been constructed in a manner much more complex than that employed by me, which method is perfectly effective and simple, not requiring any additional moving parts. I claim the manner of forming the bed piece in two parts, the rear part being hinged to the forward portion in the manner described, and for the purpose of covering the seed that has been planted, and this I claim in combination with the ridge, or keel piece, for forming and preparing the furrow, said keel piece extending along the bottom of the bed piece. I also claim the forming the bearing of the hopper upon the planting, or seeding roller, by means of a piece of leather, or other elastic material, in the manner set forth."

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58. For an improved manner of constructing the *Grates of Kilns*, used for burning lime for the manufacture of Potash, or of Salt; William B. Hill, Bellevue, Eaton county, Michigan, July 30.

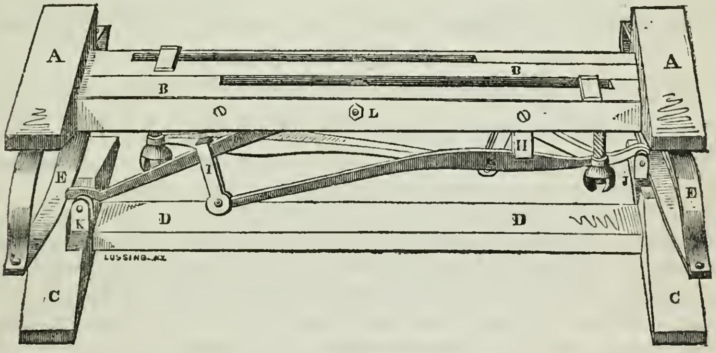
Claim.—"What I claim as new and desire to secure by letters patent, is the forming the combined bars, or fire supports, arranged as described, in part of metal, and in part of fire-proof, earthy compound, substantially in the manner, and for the purpose, described; and the combining of said compound fire supports with each other by means of a suitable frame, and of a rod, or bar, to which the swinging edges of each of them is jointed, for the purpose of opening or closing them in any required degree, by which means the draught may be regulated, and ashes, or other matter, may be readily discharged."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent granted to ELIHU RING, *of Trumansburg, Tompkins county, state of New York, for Graduating Springs for Carriages. Granted July* 29, 1841.

To all whom it may concern: be it known that I, Elihu Ring, of Trumansburg, in the county of Tompkins, and state of New York, have invented a new and improved mode of combining springs and levers, and of applying them so as to sustain the body of a wagon, or other kind of carriage, and its load, in an advantageous manner, they being, by their peculiar construction, capable of being adapted to the amount of the load which they are intended to sustain; and I do hereby declare that the following is a full and exact description thereof:

These combined springs and levers may be arranged in various ways without changing the nature of their combination and action, which combination and action are clearly exemplified in the following drawing. In this, A, A, are the timbers upon which the wagon body is to rest, and which are framed together by means of the longitudinal timbers, B, B, which may be denominated the upper spring bars. The pieces C, C, sustain the axles, and are connected together by the longitudinal piece, or perch, D, D. Between the pieces A and C are the elliptic springs, E, E, which are of the ordinary kind, and are affixed in the usual manner. When the load is light, it is principally sustained by these springs. Instead of elliptic springs, others of any of the known kinds adapted to the purpose, may be used. F and G constitute a connected lever and spring, which are so combined as to be readily adjusted, so as to exert a greater or less degree of force, as may be desired.



The spring G rests against a fulcrum piece, or block, H; is connected at its outer end to the lever F, by means of the spring I, working on a joint pin. At its inner end the spring G may be drawn up by means of a screw nut and bolt, J. The lever F bears by its outer end upon a friction roller, K—its fulcrum being the bolt L, which passes through the timbers, B, B. The spring G is necessarily made very stout, as it is intended to act under the pressure of very heavy loads. A similar lever and spring are seen in the drawing, as acting on the opposite side of the frame; and this resembles that above described, in every particular, but stands in a reversed direction.

It will be seen, that by this arrangement of the springs and levers the whole action may be thrown upon the elliptic springs; that the levers and springs may be lightly strained together, so as to bear their portion of the load when it is increased somewhat beyond that to which the elliptic springs are adapted; or that they may be brought to a high degree of tension whenever the nature of the load renders it desirable that this should be done. The upper and lower portions of the frame may advance and recede with perfect freedom, the outer ends of the levers, F, playing backward and forward upon the friction rollers, the spring G acting unobstructedly by the play of its end upon the jointed stirrup.

Having thus fully described the manner in which I combine and arrange the respective parts of the apparatus used by me, what I claim therein, and desire to secure by letters patent, is the combining with the elliptic, or other springs, occupying the situation in which they are represented—the combined levers and springs, F and G, being so connected and arranged as to operate substantially in the manner herein set forth.

These springs and levers may be increased in number; they may be placed in an inverted position, and changed in form, without materially changing their nature and action; and I do not, therefore, intend to limit myself in these particulars, but to introduce any variations which I may think proper, whilst the same result is attained by means substantially the same.

ELIHU RING.

Practical & Theoretical Mechanics & Chemistry.

MR. MALLET'S *Processes for the Protection of Iron from Oxidation and Corrosion, and for the prevention of the Fouling of Ships.*

The discovery of an effectual means of protecting iron, copper, and other metallic surfaces, from the injurious effects of exposure to atmospheric and aqueous influences, had long been an object of earnest, but nearly unavailing pursuit, as well among men of science as among mere practicians, when the successful application of iron to the building of ships gave suddenly a new impetus and great increase of importance to the inquiry. Sir Humphrey Davy had found out how to save copper sheathing from corrosion, by means of zinc protectors; but subsequent experience showed that, in proportion as the copper was thus electro-chemically preserved, it was rendered more liable to be *fouled* by the adhesion of animal and vegetable substances—an evil scarcely inferior in magnitude to that of the destruction of the copper itself; and farther than the point so reached by Davy, science had not advanced, when the first iron ship was launched into the deep. Much was at one time said of certain patented processes of zincing, by which it was alleged iron could be so thoroughly coated, as not to leave a speck unexposed for air or water to act upon—and much was hoped from them; but one after another they all proved decided failures. In the best zinced sheets of iron produced by these processes, there were always found a number of spots which had been left bare, by the collection of rust on which, the protective power of the zinc, in respect to the remainder of the iron, was almost entirely neutralized. Of "anti-corrosive" and "anti-barnacle" paints and varnishes there had been also an abundance, both before and since the days of Davy, but not one which could be said to have survived the test of practice, or which was not, more or less, of an empirical character.

So matters stood—that is to say, about the time of iron first coming into extensive use for the construction of ships—when the British Association were induced to take up the question, as one of the most practically important of the day, and to devote a portion of their funds to the institution of a series of experiments in relation to it, under the direction of Mr. Robert Mallet, of Dublin, a gentleman eminently fitted, by practical habits and experience, as well as by scientific knowledge, to do justice to the task intrusted to him. The details and results of these experiments are related in two reports made by Mr. Mallet to the Association, and published in their Transactions: and though they go little farther than to show the defects of existing processes, (that of zincing more particularly,) they must be allowed to have accomplished a most valuable service, in having cleared the subject from the vast mass of false science and erroneous practice by which it had become encumbered.

Mr. Mallet, following out the course of investigation thus auspiciously commenced, has since happily mastered all the difficulties of the case, and devised a series of remedial processes with so much of science, and therefore of sufficient reason, in them, as to leave no doubt on our minds of their perfect efficiency. To indicate briefly Mr. Mallet's discoveries, they may be said to consist, *first*, in a method of zincing iron so perfectly, that not a spot of the iron is, or can be, left unprotected; *second*, in a method of protecting iron and other metals by means of palladium, (at a moderate cost,) which renders them as incorrodible by air and moisture as palladium itself (*palladiumizing*, it may be called, with as much propriety as we say, *zincing*, or *gilding*, or *soldering;*) and, *third*, in a new paint, to which, from its life-destroying properties, Mr. Mallet has given the name of *zoofagous* paint, by the application of which to vessels, whether of wood or iron, or with whatever material they may be sheathed, *fouling* is rendered impossible. The following details of these processes, which we have great pleasure in being the first to lay before the public, we extract from Mr. Mallet's specification, which has been just enrolled.*

1. *The Zincing Process.*

Supposing the articles about to be zinced, are plates and ribs of iron, intended to be employed in the construction of an iron vessel, they are first carefully cleaned from all adhering oxide. With this view they are immersed edgewise in a suitable vessel of wood, pottery, stone, or lead, containing dilute sulphuric acid of the specific gravity of about 1.300 at 60° of temperature, or dilute hydrochloric acid of the specific gravity of about 1.060 at 60° of temperature, formed by diluting these acids respectively as they are usually found in commerce with rather more than an equal bulk of water. As it is of importance that the scales of oxide should be detached as rapidly as possible, the diluted acid should be warmed; and this may be conveniently effected by means of a steam jacket round the vessel, or by blowing steam into the acid; the acid vessel, or "Cleansing Bath," as it may be termed, should be so constructed for operations on a great scale, that the lower portion of the acid, and the scales which are precipitated, can be occasionally withdrawn to prevent waste of acid, or the cleansing process from being inconveniently protracted. The iron must be wholly, not partially, immersed, and the bubbles of gas formed on its surface must be free to ascend in the fluid and escape. As soon as the scales of oxide have become detached, or loosened, the articles are to be removed from the "cleansing bath," thrown into or washed with cold water, and struck or hammered to shake off and detach the scales. In the case of flat boiler plates, they may be advantageously passed backwards and forwards, through the machine known to boiler makers as "a mangle." The surfaces of the iron are then to be thoroughly scoured, by hand or by any suitable machinery with sand or emery, or with pieces of grit stone, while exposed to a small running stream of water, until they appear quite clean and of a bright metallic lustre. The articles are now, before being allowed to dry, to be plunged into a "preparing bath," consisting of the following mixture: A saturated cold solution of chloride of zinc is made by dissolving zinc or its oxide in hydrochloric acid; to this is added an equal bulk of a saturated cold solution of sal ammoniac; and to the mixed solutions as much more sal ammoniac in the solid state is added, as they will dissolve. Or, these solutions may be made and mixed hot, and the solid sal ammoniac then added, but the addition of some cold water will then be requisite to dissolve the whole of the salts so formed. The bath may also be formed of sulphate of zinc and sulphate of ammonia, or acetate of zinc and acetate of ammonia, or of any other soluble salt of zinc and ammonia or salt of manganese and ammonia. The nitrates of zinc and ammonia are the least advantageous, and it is stated that none answer the purpose so well as the chloride of zinc and sal ammoniac first before directed to be used. No free acid should be present in these solutions. As soon as the surfaces of the immersed articles appear covered all over with minute bubbles of gas they are then in a fit state for combining with the metallic alloy with which they are next directed to be coated; but they may be allowed to remain in the preparing bath for any convenient length of time without injury or prejudice to the subsequent processes. The metallic alloy last referred to is prepared in the following manner: A quantity of zinc is melted in a suitable vessel (one formed of pottery or stone is found to answer best,) and when it is in a state of fusion, mercury or quicksilver is added, in the proportion of 202 parts of mercury to 1292 parts of zinc (both by weight) being in the proportion of one atom of mercury to forty atoms of zinc, both upon the hydrogen scale. The two metals are well stirred or mixed together with a rod of dry wood or of iron coated with clay; and when this has been done there is added one or the other of the metals know to chemists and others as potassium and sodium (the metallic bases, of which the well known alkalies potash and soda, are oxides) in the proportion of a pound or thereabouts of potassium or sodium to every ton weight of the alloy of zinc and mercury, or in some cases less will suffice; either potassium or sodium will answer the purpose, but Mr. Mallet prefers the latter, as more easily obtained and more manageable. Whether it is potassium or sodium which is used, it is removed from the naphtha, or other fluid in which it is customary to keep these metals in order to preserve them from oxidation, in small portions of not more than half an ounce at a time, and by means of a small inverted cup of wood, formed on the end of a stick, thrust rapidly below the surface of the alloy of zinc and mercury, so as to avoid any waste or combustion of the alkaline metal. A triple alloy is thus formed of zinc, mercury, and sodium or potassium, which having been again stirred and mixed with the rod of dry wood, or of iron coated with clay, is now ready for covering or coating the prepared iron. The combination of these metals is facilitated, and their oxidation on the surface retarded, by pouring upon their fluid surface some of the liquor of the preparing bath, or strewing upon it some of the salts dissolved in that liquor in a dry state.

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* Enrolment Office, January 7, 1842.

The plates or ribs of iron are now to be taken up out of the preparing bath, permitted to drain for a few seconds, and while still wet with the liquor of the preparing bath, immersed in the triple alloy in a state of fusion. As soon as they have acquired the temperature of the bath of alloy, they are to be withdrawn from the metallic bath edgewise or endwise, when they will be found covered with a perfectly uniform and coherent coat or surface of the alloy. The affinity of this alloy for iron is, however, so intense, and the peculiar circumstances of surface as induced upon the iron presented to it by the preparing bath are such, that care is requisite lest by too long an immersion the plates are not partially or wholly dissolved. Indeed where the articles to be covered are small, or their parts minute, such as wire or nails or small chain, it is necessary before immersing them to permit the triple alloy to dissolve or combine with some wrought iron, in order that its affinity for iron may be partially satisfied and thus diminished. At the proper fusing temperature of this alloy, which is about 680° Fahr. it will dissolve a plate of wrought iron of an eighth of an inch thick in a few seconds. No sputtering is produced by the immersion of the iron wet from the preparing bath into the alloy; but care is to be taken that there are no hollow places or cavities in the articles immersed which the alloy cannot wholly fill; lest in such case steam may be generated below the surface of the metal, and a dangerous explosion be thereby occasioned. It is stated to be desirable that the melting vessels should be as deep and expose as small a surface as the nature of the articles to be immersed will allow. At the moment of immersion of the articles, the surface of the alloy is to be cleansed of all dross or oxide by a wooden skimmer. As soon as the iron plates or ribs are withdrawn from the alloy or "Metallic Bath," they are to be plunged into cold water and well washed therein. The surface of the iron is now in a condition permanently to resist corrosion and oxidation in air, or in salt or fresh water.

All the foregoing operations are best performed upon the plates or ribs after they have been bent and fitted to their places, and the plates have been riveted together into large pieces of eight to ten feet square or more. When again put "into frame," or placed in their respective positions in the ship's hull, they are directed to be united by rivets countersunk from the outside, and consequently headed inside the vessel. The countersunk heads of these rivets are to be also coated with the triple alloy in the manner before described, and tongs of iron are to be provided, having a very large mass of metal in their jaws, between which a hollow seat, of the shape and size of the countersunk rivet head, is to be formed to receive it. An alloyed rivet being seized by a pair of such tongs may have its point heated to a riveting or welding heat without injuring the coat of alloy upon its countersunk head; for the heat is carried off from the latter so fast by the contact of the large mass of iron in the jaws of the tongs, which are to be cooled occasionally, as to prevent the head of the rivet becoming hot during the heating of the point in a common smith's fire.

The hull of the iron vessel, being thus completed, and wholly covered with the alloy, is then to receive a coat of varnish all over, of either of the compositions about to be described. If possible, this varnish should be laid on with a spatula or thin flexible blade of horn, or some such material, as a brush produces minute air bubbles, which leaves spaces uncovered on the drying of the varnish. The varnish will dry, or get hard and coherent, at ordinary temperatures; but when practicable, it is desirable to expose it for some hours to a temperature of about 300° Fahrenheit, which gives it greater adhesion and durability. The iron surfaces may be warmed in successive portions by heat radiated from "chauffers" or open fires of coke, or by any other convenient means. The varnish may be either of a composition, which Mr. Mallet terms No. 1, or of another, which he terms No. 2. The composition No. 1, is formed as follows:—Take 50 lbs. of foreign asphaltum, melt and boil it in an iron vessel, for three or four hours; add gradually 16 lbs. of red lead and litharge ground together to a fine powder in equal proportions, with 10 imperial gallons of drying linseed oil, and bring all nearly to a boiling temperature. Melt in a separate vessel eight pounds of gum anime (which need not be of the clearest or best quality;) add to it two imperial gallons of drying linseed oil, boiling, and twelve pounds of caoutchouc softened, or partially dissolved by coal tar naphtha (as practised by the makers of water-proof cloths.) Mix the whole together in the former vessel, and boil gently until, on taking some of the varnish between two spatulas, it is found tough and ropy. When this "body" is quite cold it may be thinned down, with from 30 to 35 gallons imperial of turpentine, or of coal naphtha, which will make it ready for use. Mr. Mallet states this to be the best varnish he is acquainted with for this purpose. It is not acted on when dry and hard, by any moderately diluted acid or caustic alkali; it does not by long immersion combine with water, and so form a white, and partially soluble hydrate, as all merely resinous varnishes and all oil paints do; it is, moreover, so elastic, that a plate covered with it may be bent for several times without its peeling off. And, lastly, it adheres so fast, that nothing but a sharp edged instrument will scratch it off the surface of iron. The composition No. 2 is of a cheaper sort, but not quite so good. Common coal or gas tar is to be boiled in an iron caldron, at so high a temperature, that the smoke from it is of a yellow dun colour; or the tar is to be caused to flow through red-hot iron tubes. The boiling passage through the tubes is to be continued until the residue is a solid asphaltum, breaking with a pitchy fracture. It is essential that the boiling should be carried on at this high temperature, as the permanence of the varnish in water depends upon the tar having been submitted to the temperature at which naphthaline is formed, by the decomposition or breaking up of the original constitution of the tar. Take 56 lbs. of this coal tar asphaltum; melt it in an iron vessel: add ten imperial gallons of drying linseed oil, ground with twenty-five pounds of red lead and litharge, in equal proportions; add to the whole, when well mixed, and after boiling together for two or three hours, fifteen pounds of caoutchouc, softened or partially dissolved by coal naphtha, as before described; and when cold, mix with from twenty to thirty gallons of turpentine, or coal naphtha, which will make the varnish ready for use.

[TO BE CONTINUED.]

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Fabrication of Gas for lighting from Soap-suds employed in cleansing stuffs. By M. HOUZEAU MUIRON.

A few years ago the immense quantity of soap-suds employed in the city of Rheims in preparing woollen stuffs was entirely lost. M. Houzeau Muiron conceived the idea of extracting from them the fatty matter, and of making an important application thereof. In fact, by submitting them to a regular purification, he has obtained a limpid oil, with which he succeeds in preparing the soaps in demand in commerce, while the residue of this purifaction serves for the advantageous production of a gas for lighting a part of the city.

The soap-suds collected in the shops, where they have become saturated with grease and the impurities of the tissues, are poured together into a large basin which is capable of containing about 3,000 gallons. To decompose them, there is poured upon them 308 pounds of muriatic acid, or 154 pounds of sulphuric acid, first diluted with its own weight of water, and the mass is rapidly agitated until the decomposition is complete.

Shortly afterwards a froth is seen to form, which at the end of twelve or eighteen hours is sufficiently well separated from the water upon which it floats. Four-fifths of this water is then run off, containing about one per cent. of sulphate of potassa which is utilized either by evaporating it in drying-houses, or by running it off upon dry earth exposed to the air, which when sufficiently charged with the salt is washed. Directly after this operation, the basin is filled again with a fresh portion of soap-suds, which float the fatty matter and permit it to be run off into a side tub. The product obtained is a mixture of unaltered oil, the acids, animal matters and a large quantity of water which forms with them a species of hydrate. This water is disengaged by injecting several times into the mass a current of steam which heats it and facilitates its evaporation. The fatty matter is then run off into a boiler where it is submitted to a rapid ebullition, aided by continual agitation, which drives off the last portions of water. The product contains twenty or twenty-five per cent. of impure matters which colour it and render it turbid. To purify it, it is poured into basins of copper and mixed with two per cent. of concentrated sulphuric acid. After two days the limpid oil comes to the surface, while the impurities are precipitated to the bottom.

The oil is carefully separated, and the deposit, when filtered through cloths in a press, gives still a large quantity of oily products, which are added to the preceding and made into soap by treating them with common soda.

The residuum is black and very thick; from it M. Howzeau produces the gas for lighting, but before introducing it into the retort, he liquifies it by means of the empyreumatic oil obtained in the preceding operation.

The gas thus prepared is purified by lime, and the water from the washing contains sufficient cyanide of calcium for the preparation of Prussian blue from it, by treating it with sulphate of iron and washing the precipitate with muriatic acid.

This gas possesses a considerable lighting power, and in order to apply it to the lighting of the establishments scattered throughout the city of Rheims, M. Houzeau has contrived a manner of transporting it, at the same time simple, economical and free from danger.

F. Boudet.

Jour. de Pharm. et de Chim., May, 1842.

Robert Stephenson's *New Locomotive.*

With the progress of the locomotive engine, it has, like other machines of extensive use, attained that period when its economy becomes of the greatest importance. Influenced by such considerations, Mr. Robert Stephenson has directed his attention to a less consumption of fuel, and to effecting a more simple arrangement of the machinery, both of which points have been well managed in his new engine now running on the York and North Midland Railway.

Economy in the consumption of fuel has been obtained, by adding considerably to the length of the tubes, without increasing the distance between the front and back axle of the engine; consequently the space occupied by the engine upon the bearing is precisely the same, therefore no alterations are requisite in the turn-plates, or other arrangements made for the accommodation of the ordinary locomotives. The machinery is simplified by placing the axles of all the wheels under the cylindrical portion of the boiler, the axle of the front wheels being placed close to the smoke box, and the axles of the hind wheels close to the foremost end of the fire box, instead of the back part. This arrangement allows the axle of the driving wheels to be placed in the centre of the other two axles, or at such intermediate distance as may be found the most suitable for the moving parts.

The alteration in the construction of the boiler and tubing gives a heating surface of 800 superficial feet, whereas in the ordinary engine it rarely exceeds 450 feet, being for the new plan a superiority of fully 350 feet. Such is the effect produced by this addition, that the temperature of the air escaping in the chimney scarcely exceeds the temperature of the water in the boiler; a circumstance which has a farther beneficial effect beyond the economy of fuel, for it has been found, by increasing the extent of heating surface, and employing usefully the whole of the heat generated in the fire, that a less violent draught of air is required; the consequence is that very few hot ashes are thrown out of the chimney; this peculiarity is quite remarkable in the engine now running. A few days since, a journey of ninety miles was performed by this engine, during which no ashes were thrown out of the top of the chimney, and at the same time the accumulation in the smoke box was very trifling, not exceeding a fourth of the usual quantity. As the tendency to eject ashes from the chimney is dependent upon the speed, it is necessary to state, that the speed was never below twenty miles per hour, generally exceeded thirty, and for several miles a speed of forty-eight miles per hour was uniformly attained, with five loaded coaches.

The consumption of fuel during the above experiment was 19.2 lb. per mile, with a load of eight coaches over half the distance (forty-five miles,) and five coaches over the remaining half. This consumption includes the whole of the fuel used in lighting the fire and raising the steam.

We may truly say, that we have never witnessed an instance where speed and economy were combined to the same extent; indeed, under no circumstances have we heard of the consumption of fuel being reduced to so low a figure. It must, however, be borne in mind, that this result is from a single experiment, and that we must not be deluded by isolated trials; but we are glad to hear that on the line where the engine is now working, the Company have ordered an accurate record of the performance, and quantity of fuel consumed during each trip, which we hope will be made public.

Mr. Stephenson has introduced tubes of wrought iron, instead of brass or copper, in order that the increased heating surface might be obtained without a corresponding augmentation in the price of the engine. This he has not adopted without making several experiments. During the last twelve months, he has had several boilers working under his own eye with iron tubes, for the special purpose of determining how far he could recommend them for general adoption. The result has been all that he could desire; and it is owing in some degree to this, that he has introduced them with greater confidence.

Having now described the modification in the boiler, we shall proceed to point out Mr. Stephenson's alterations in the mechanical arrangement. In the ordinary engines, the mechanism for working the slide valves is very liable to derangement, and considerable wear and tear. This part of the engine he has so far simplified, as to require only a simple connection between the eccentrics and slide valves, thus doing away with a considerable number of moving parts, which have hitherto given rise to more casualties than any other part of the ordinary engine. This is attained by placing the slide valves vertically on the sides of the cylinders, instead of on the top, as heretofore, so that the direction of the sliding motion of the valves, and the central line of the valve rods, will intersect the central line of the main axle, at the point where the eccentric is placed. In this case, the eccentric rods are connected immediately to the prolongation of the valve rods, without the usual intermediate levers and weigh bars; besides, the slide valves of both cylinders are placed in one steam chest, between the cylinders.

Another improvement is that effected in the working of the feed pumps: it consists in connecting the pump rods to the eccentrics used for reversing the engine. By this arrangement, the velocity of the moving part of the pump is greatly dimished, by which is secured greater regularity in action. In addition to what we have already described, there are several minor alterations, which we cannot fully explain without giving detailed and elaborate drawings.

The following are the principal dimensions of the engine now working on the York and North Midland Railway:—

Diameter of cylinder - - -	14 inches.	
Length of stroke - - - - -	20 "	
Diameter of driving wheels - -	5½ feet.	
Ditto of small ditto - - - -	3 "	
There are 150 tubes, giving a heating surface of		765 feet
Copper fire box, with a heating surface of - -		30 "
Total heating surface		795 feet.
Length of boiler, including fire and smoke boxes		17 feet.
Weight of the engine in working order		15 tons.

Civ. Eng. & Arch. Jour., Feb. 1842.

A New Cement, a substitute for Glue and Caulking.

Amongst the numerous inventions submitted to the Lords Commissioners of the admiralty, and referred by their Lordships to the committee of master shipwrights recently sitting at Woolwich dockyard, was a composition to be used in place of the substance with which vessels are at present caulked to render them water-tight. The experiments ordered to be made by the master shipwrights to ascertain its value when applied to the purpose for which it is intended, and the result, are interesting and satisfactory. Two pieces of African teak, a species of wood difficult to be joined together by glue, on account of its oily nature, had a coating of the composition applied to them in a boiling state, and in a short time afterwards bolts and screws were attached to each end, the joined wood placed in the testing-frame, and the power of Bramah's hydraulic engine applied to the extent of nineteen tons, when the chain broke without the slightest strain being perceptible where the jointing took place. A larger chain of one inch and a half in diameter was then applied, which broke with a strain of twenty-one tons, the joint in the wood remaining apparently as firm as at first. The utmost strain the cement can bear in this form, therefore, remains to be proved when experiments are made with larger chains. Four pieces of hard wood were then joined together, weighing in one piece forty-four hundred weight, and carried to the top of the shears in the dockyard, a height of seventy-six feet, from which it was precipitated on the hard granite wharf wall below, without any of the joints yielding in the smallest degree. The results of these severe tests induced the Lords Commissioners of the Admiralty to communicate with Lieutenant-General Sir George Murray, G.C.B. and G.C.H., for the purpose of making experiments with it in the marshes at Woolwich, by bringing the full force of cannon balls against it. Accordingly, a number of planks of oak eight inches thick and fir sixteen inches square, were joined together with the cement, to together eight feet in height and eight feet in length of the side of a first rate ship of war, without any thing else in the shape of bolt or security to assist the composition; and it was set up as a target at the butt in the marshes; when a number of officers of the Royal Artillery were present to witness the experiment. Three shots were first fired, every one entering the target, the third in a direct line with the bull's-eye within three inches of its outer circle. The effect of these shots were wonderful, they tore the wood to pieces, and excepting in one instance, where the joint had not been good, they had no effect upon the cement. A hole six inches and a quarter in diameter was then bored in the centre of the target, and a thirty-two pounder shell inserted and exploded by a match, which tore the wood to small splinters without in many places in the least separating the composition. This new invention is said to possess the power of expanding like Indian rubber in warm climates, and will not become brittle under the coldest temperature. It appears to be a great favourite with naval officers, as it is so clean, having only the appearance of French polish. The name of the inventor is Mr. Jeffrey.

The substances of which *the cement is composed* are simple, being merely *shell-lac and Indian rubber dissolved in naphtha* in certain proportions; and being insoluble in water, the purposes to which it may be applied are numerous. Its value is about half the expense of common glue, the saving to the country by its universal adoption will be incalculable, as the inventor has been employed in experiments with it for upwards of two years, and has found that in the absence of great friction it is in a manner imperishable. An experiment was tried in the dockyard, which shows the value a supply of the cement will be of to vessels which may be damaged at sea. Eight pieces of wood were joined together in the form of a mast, and a strain applied to them and to another mast of one piece of wood. The latter gave way first, and the other only broke after being considerably bent and the application of a rather great strain. By this substance, therefore, it is certain that ship carpenters can have no difficulty in effecting repairs at sea, which could not be done under any other circumstances.

Ibid., June, 1842.

Dreadful explosion of a Steamer and Melancholy Loss of Life.

Our readers are aware that a fine fast-sailing steamer named the *Telegraph,* was lately built for the river trade, for the purpose of competing with the railway. She has been plying for some time back, and being on the high pressure principle, has beaten the swiftest steamers in the passage to Greenock. To-day, about half-past 12, the people on the steamboat quay, Greenock, heard a report as if a battery of cannon had been discharged at Helensburgh, (a distance of four miles.) A smoke was seen to arise, and telescopes being procured, the explosion of the *Telegraph* was immediately discovered. Two of the tug steamers lying at Greenock quay got their steam up, and sailed for Helensburgh, to render whatever assistance they could. On arriving at Helensburgh they found that the *Telegraph's* boiler had exploded, and that the hull of the vessel was a total wreck, and literally floating away in pieces. At the time our informant left, it had been ascertained that thirteen had been killed outright, but as strangers were on board, it was impossible to arrive at a true statement of the casualties. A number of persons were seriously wounded, some of whom are not expected to recover, and among the latter we are sorry to say is Captain Ewing, late of the Kilmun steamer, who was just alive when our despatches were sent off. It appears that the passengers for Helensburgh had all landed, and that the boat was about to proceed on her passage up Gairloch when the explosion took place. Something connected with the management of the valves is supposed to have caused the accident. Let this be as it may, we are inclined to think that the melancholy loss of life will be the means of putting an end to the high pressure system of propelling steamers on the Clyde. We have heard that four of the dead belong to Glasgow, and formed a part of a company of eight painters who had gone down to paint a house on the banks of Gairlock. Mr. Hedderwick, of the late firm of Hedderwick & Co., shipbuilders, is among the missing.—*Glasgow Chronicle, March* 21. Railway Mag. March, 1842.

Vapours in Smelting Furnaces.

M. Eblemen read a memoir before the Paris Academy of Sciences, Feb. 1, on the nature of the various vapours developed in smelting furnaces, as observed at different altitudes within the furnace. The object of such researches was to determine the degree of heat at various points, and to devise means for the improved regulations of the fires. He has arrived at the following results—1. The gaseous vapours, on coming out of a furnace heated by charcoal or wood, contain watery vapour, carbonic acid, and oxides of hydrogen and azote, but no carbonated hydrogen. At six or eight feet below the mouth of the furnace the watery vapour is not found, and the proportion of oxide of carbon increases, while those of hydrogen and carbonic acid diminish, according as the observations are made lower and lower down in the furnace.—2. When coal is used jointly with wood for heating the furnace, the carbonization of the vapours takes place in an internal zone, and the water is expelled from the metal at a very low altitude. He found that the proportion of gas which traverses a certain zone of the furnace per minute, is greater according as it is further from the bottom of the furnace. Athenæum, Feb., 1842.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

AMERICAN REPERTORY.

OCTOBER, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Reaction Water Wheels used in the United States; and on the Turbine of M. Fourneyron, an Hydraulic Motor, recently used with the greatest success on the continent of Europe.

By Ellwood Morris, Civil Engineer.

By way of preface, following a similar classification to that indicated by the celebrated Smeaton, in his experiments on water wheels, we may, with propriety, rank these hydraulic motors under three general heads, to which, *directly or indirectly,* they may all be referred. Viz:

1*st class.* *Wheels actuated by pressure,* such as overshot wheels.
2*nd class.* *Wheels actuated by impulse,* such as undershot wheels.
3*rd class.* *Wheels actuated by impulse and pressure combined,* such as breast wheels.

It is evident, however, that this last class may be made to vanish into either of the others, according as pressure or impulse is mainly applied; and in perfect strictness, all water wheels, may be brought under the *third class,* for even overshot wheels are actuated in part, though it be but a small part, by the impulse of the water issuing into the buckets; whilst undershot wheels, though mainly impelled by impulse, owe a small part of their motion to pressure, for the water striking the floats in a thin sheet, follows and rises against them, so as to bring a certain pressure into play, more especially if it be discharged against the wheel a little above its bottom, and then confined by a sweep, as is often done.

Yet as in making almost any general classification of machines, we are under the necessity of ranking them according to their *prevailing characteristics,* the above nomenclature is perhaps as expressive as any we could adopt for general purposes, and certainly has a basis in well understood practical distinctions.

Each of these classes has a particular ratio of effect, produced by a given power expended; this ratio is usually expressed by a decimal co-efficient, assuming the power to be unity; and is here regarded as applying to the total fall of the water, or to the *head and fall,* as it is usually termed.

Thus in wheels of the

1*st class, the co-efficient of effect* is usually from 0.700 to 0.800.
2*nd class,* do. do. do. 0.350 to 0.400
3*rd class,* do. do. do. 0.500 to 0.600

The *co-efficient of effect* of wheels of the first class is assumed for our present purposes at 0.700 to 0.800, in consequence of the able experiments of the Franklin Institute having shown that under favorable circumstances, even *eighty-four per cent.* of the power expended may be realized by overshot wheels; whilst Smeaton's experiments developed a ratio of power and effect of 3 : 2, giving 0.666 for the co-efficient of effect.

The same co-efficient for wheels of the second class, is deduced from that of the first, by the comparative ratio shown by Smeaton to subsist between overshot and undershot wheels, viz: that the latter, in situations adapted to their use, realized but *one-half* of the useful effect attained by the employment of the former at proper sites.

This co-efficient has been collaterally verified, in experiments made by French officers upon *wheels of impulse* at Toulouse, of the species we call *tub wheels,* of which the ratio of effect to power proved to be 0.342 to 1.

We shall hereafter see that *reaction water wheels,* which we regard as *wheels of impulse,* or as belonging to the second class, had, in one experiment, also a co-efficient of 0.400; that in another where the precise ratio could not be determined *directly,* it was *indirectly* found, by showing that the wheel under trial returned an available effect but *half as great* as a wheel of the first class, and that, therefore, as a necessary consequence, its co-efficient of effect must have approximated in that case also to 0.400; and it will be further shown, that, tried upon a low fall for several years, reaction wheels proved to be inferior in economy of water, to common breast wheels, whence the conclusion is inevitable, that their co-efficient in this case *must have been* less than 0.500.

On the other hand, the *turbine* of M. Fourneyron, has been proved by the able experiments of Capt. Morin, to have a co-efficient of 0.700 to 0.780, or to realize a useful effect, of about three-fourths of the power expended; which is very nearly coincident with that which we have assigned to the *wheels of pressure,* or those of the first class, amongst which we place the *turbine.*

We will finally mention the position in the scale of effect, which it seems to the writer, may be fairly assigned to the various water wheels *in common use.*

1st class. *Wheels of pressure.*—Overshot wheels, pitch-back wheels and turbines; *co-efficient*=0.700 to 0.800.
2nd class. *Wheels of impulse.*—Undershot wheels, tub wheels, flutter wheels, and reaction wheels; *co-efficient*=0.350 to 0.400.
3rd class. *Wheels of pressure and impulse combined.*—Breast wheels; *co-efficient*=0.500 to 0.600, but upon low falls where they are commonly employed, rarely exceeding 0.500.*

As it is not by any means our purpose however, to enter into a general discussion of the subject of water wheels—which has been already confided, by the Franklin Institute, to a very able committee, engaged in elaborating, and publishing, the valuable results that flow from a prolonged series of experiments, made by them some years since—and having already said enough upon the general question, to enable an idea to be formed of the comparative value of the *reaction* and *turbine* wheels, which are the particular objects of this paper, we will now confine ourselves more strictly to these subjects.

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* At Fairmount Waterworks, for example, about thirty gallons expended upon the breast wheels with eight feet fall, raise one gallon ninety-six feet into the reservoirs. *To find the co-efficient?*

$\frac{30\times 8}{1\times 96}=2\frac{1}{2}$ whole power expended for 1 raised to the same height.

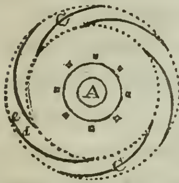
Deduct power lost by the application to a breast wheel, say *one half*	$=1\frac{1}{4}$
	$1\frac{1}{4}$
Deduct friction of pumps, say 20 per cent.,	$=\frac{1}{4}$
Reduced effect thereof	$=1$

From this rough estimate it appears, that if the friction of the pumps, &c., is 20 per cent., then these breast wheels realize an effect of $1\frac{1}{4}$, for a power expended of $2\frac{1}{2}$, or have a co-efficient of 0.500, which confirms what we have above stated upon this point.

Of Reaction Water Wheels.

Reaction water wheels are a very numerous family, of which the well known hydraulic motor, called Barker's mill, is the parent; those used in various parts of the United States, have usually vertical axes of rotation, and curved buckets, or vanes, against which the impulsive force of the water, (spouting from within the wheel by ajutages of which the curved vanes form the sides) *acts indirectly*, or rather *reacts*, thus producing (in reference to the effluent water) a *backward rotary motion*, similar in character and effect, to the *forward rotary motion*, produced by direct impulse in the case of undershot wheels.

It is only, comparatively speaking, quite recently that reaction water wheels, of the form at present in use in the United States, have occupied a prominent position before the public.



In 1830, Calvin Wing took out a patent for a *reaction water wheel*,* with curved vanes of the figure shown in the annexed horizontal section, in which A is the place of the vertical shaft, C C the curved vanes or buckets, *e d* lap of the vanes; the width of the orifice at *e* being always *less* than at *d*.

In this species of wheel the water has free entrance to the circular space within, and spouting out by the openings between the curved vanes, impels the wheel around in a backward direction, by its *reaction* against the vanes, in issuing, *with velocity*, from within the wheel.

Fig. 1.

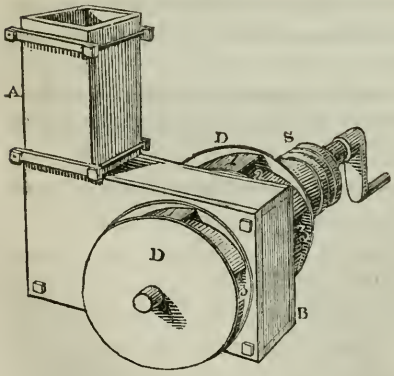


Fig. 2.

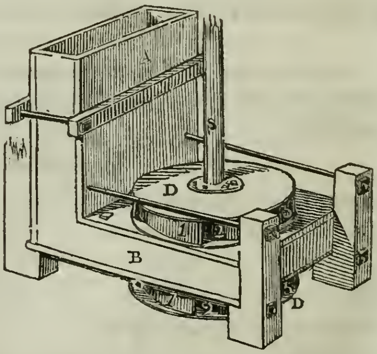


Fig. 1 shows *a double reacting wheel* placed on a horizontal shaft S, the penstock being marked A, the cistern or feeding reservoir

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* See specification in the Journal of the Franklin Institute, vol. vii, p. 86, some of the illustrations of which are reprinted above.

B, and the two water wheels respectively D and D, which revolve in vertical planes as indicated in the cut.

Fig. 2 is *a double reacting wheel* on a vertical shaft, A being the penstock, B the cistern or feeding box, and D, D, the water wheels revolving horizontally.

Mr. Wing in his specification lays considerable stress on the necessity of causing the vanes to lap by each other, in the ratio of one and a half inch lap, for each inch of the width of the ajutage, or shortest horizontal distance between any two adjacent vanes; he proposed also to employ his wheels either upon vertical or horizontal axes, and they have been made and used in both ways, as shown in the cuts.

Wing's patent is the earliest one referring to this general form of *reaction water wheel,* which the writer, in a brief search, has been able to find on record; but he has good reason to believe that reaction wheels remarkably similar, if not exactly the same in principle and outline, were tried upon the Brandywine, and abandoned, some years previous to 1830; and that therefore the invention had been antecedently made, and probably patented before.

Since the date of Wing's patent, many others have been taken out for reaction water wheels, but most of these subsequent inventors, have evinced by their productions, a perfectly accurate knowledge of the wheel patented by Wing, for it is a very difficult matter to distinguish them from it, or from each other, and this striking resemblance in general form, becomes identity as to *principle* involved; and with equal accuracy of workmanship, it would seem to be impossible that they can differ more in effect, than would be the case in as many undershot wheels, built by different millwrights, each according to his own fancy.

This view is confirmed by experiments upon two of the most dissimilar, (hereafter cited,) which indicate, that the *co-efficient of effect* in both cases was about 0.400—in fact coming under the general category of *wheels of impulse,* the writer believes that *reaction wheels* will be found, without exception, to approximate as closely in their results, to the co-efficient of this class, as can or ought to be expected, in practical affairs of this nature.

In the American Philosophical Transactions, 1793, William Waring, a mathematician of celebrity, investigated, analytically, the subject of reaction water wheels, in examining the merits of Rumsey's improvement of Barker's Mill, and the conclusion to which he came, after a train of reasoning based upon scientific principles, was, that they were *merely equal in effect to undershot wheels.*

And he came to the same conclusion from the following brief argument.

"*Action and reaction are equal.*" "But the undershot wheel is propelled by the *action*, and (Barker's Mill) by the *reaction* of the same agent, or momentum. *Therefore their mechanical effects must be equal.*"

This conclusion, which is strictly accordant with that to which all the information upon this point tends, which it has been in the power of the writer to collect; was further enforced by Mr. Waring, with reference to the elementary laws of forces, as laid down in Newton's Principia; and his article upon this subject, to which we have allusion, will be found interesting by such as feel disposed further to investigate this important question.

In the year 1833, the writer's attention was closely drawn to the matter in hand, in consequence of having been called upon by a friend to examine for him a *reaction water wheel*, in the patent right for which he had been invited to take an interest, and which had just been put into use.

In consequence of this application the writer visited a grist mill, where a *breast wheel* had just been removed by the proprietor, to make room for this reaction wheel, which, like most of the others, resembled *very closely* that of Calvin Wing.

At this grist mill the writer made the following experiment, after it had been put in action by the reaction wheel; and though this trial could not, under the existing circumstances, be made as accurate in its character as might have been desired; still it was sufficient for the purpose of ascertaining *approximately* the useful effect derived, as compared with the work of overshot and undershot wheels, in common use; which comparison was the best test of the probable value of the patent right, as it could only be valuable, by superseding the common wheels, which the inventor (as is usual) was perfectly confident that his *reaction wheel* would speedily do.

Experiment on a Reaction Water Wheel applied to a Grist Mill, February 4, 1833.

This mill was double geared, in the usual manner, with beveled gearing, the first motion being given from the vertical shaft of the reaction wheel, by a beveled wheel of thirty-five teeth, mashing into another of forty teeth, placed at one end of a lying shaft leading into the mill, on the other end of which was,

The master cog wheel, working into
The wallower, working into
The counter cog wheel, working into
The trundle head, carrying the millstone.

The millstones were four feet in diameter, in very bad order, out of face, and the bush loose.

Top of the reaction wheel twelve inches under the water in the tail race, working under four feet head and fall, being the whole difference between the upper and lower level; ground *very badly* three and a quarter bushels of rye, by measurement, in an hour; expense of water equal to the whole quantity passing over a wasteboard set up for the purpose in the penstock, and having a clear fall below.

Length of wasteboard eighty-five inches, depth of the edge beneath surface of water above it, ten inches; quantity of water discharged, calculated by the well known formula of Du Buat, as verified by Dr. Robison, and long employed by Engineers as an accurate mode of determining the flow of water over a wasteboard, = 1200 cubic feet per minute.

During the above trial the bolting apparatus, consisting of a single reel and cloth, was in gear, but there was neither conveyer, hopper-boy, nor elevator in the mill.

In fine, the conclusion drawn by the writer at the time, from this experiment, (though necessarily approximative only) was, that if it were assumed, that with every thing in good order, such a wheel in a completely fitted mill, could grind and dress three bushels of wheat per hour on a four and a half feet stone, by the use of 1200 cubic feet of water per minute, with four feet head and fall, *it would be a conclusion as favorable to the reaction wheel tried, as could possibly be admitted from this experiment.*

Now 1200 cubic feet multiplied by four feet head and fall, and divided by three bushels of wheat = 1600 *cubic feet of water falling one foot per minute for sixty minutes, required to grind and dress one bushel of wheat by this reaction wheel.*[*]

To compare, therefore, the work of this wheel with that of others, it was only necessary to ascertain the same factor for an overshot wheel, the relation of which, to undershot and breast wheels, having been already determined with practical accuracy by Smeaton; to ascertain this, therefore, was at once to secure the means of contrasting this reaction wheel, with either of the three.

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[*] This amount of water required, seeming considerably larger than would have been needed by a breast wheel, to do the same work, induced the writer, upon the spot, to declare an opinion unfavourable to the economy of the reaction wheel under trial, in consuming water; which opinion was, of course, but ill received by the sanguine patentee.

And the proprietor of the mill also, where it was erected, was so well pleased with his new wheel, as to be evidently indisposed to hearken to any suggestions adverse to it; consequently the only course was to leave these parties to the action of time and experience, before which no bad machine can long stand; and the result has been that this reaction wheel was long since discarded, by that same proprietor, as incapable of doing the requisite amount of work; whilst the then repudiated breast wheel has been restored to favour and to duty.

For this purpose the writer, at first, resorted to books of the highest authority in this branch of mechanics, but amongst them he found great and irreconcilable discrepancies, as to the quantity of water falling one foot per minute (upon an overshot wheel) for sixty minutes, which was necessary to grind and dress a bushel of wheat in one hour; the variation between these authorities, in reference to the amount required, ranging from 300 to 1344 cubic feet per minute!

Under these circumstances, the writer resolved to ascertain for himself, the actual quantity consumed in practice here, upon overshot wheels; for this purpose he selected and examined *three excellent overshot mills,* containing all the modern improvements, and found that, calculating by the whole head and fall, they required when running at their common working pace, and with every thing in the usual order, 788 *cubic feet of water falling one foot each minute, to grind and dress one bushel of wheat in an hour.**

Consequently by the known ratio subsisting between overshot and undershot wheels, the latter in doing the same work would use 1576 cubic feet of water in the same time.

Hence as we have seen that the reaction wheel required 1600 cubic feet to do the same work, and knowing also the co-efficient of effect for undershot wheels, we have the following proportion.

1600 : 1576 : : 0.400 : 0.394

Consequently the co-efficient of effect in reaction wheels, as inferred from this experiment, assuming the co-efficient of undershot wheels to be 0.400, is 0.394, or nearly coincident therewith.

A similar fate to that which befell this reaction water wheel, the subject of the foregoing experiment, (as stated in the preceding note) has likewise happened to other wheels of the same species, as we shall now mention; and will probably also befall, the greater part of those yet in use, so soon as the merits of the French *turbine*—that admirable hydraulic motor, which possesses all the *advantages,* and none of the *disadvantages,* of reaction wheels—shall become better known, and be appreciated, as they will be, when fairly understood.

The American experience which has now been had with the water wheels of impulse, commonly called reaction wheels; where fair comparative trials have been made with them against others, may, in a great measure, be gathered from the following history of the proceedings of a distinguished and intelligent manufacturer, (the owner of several large mills) whose name the writer does not feel at liberty to mention, but whose letters upon the subject of his practice with reaction water wheels, have been placed in the writer's hands by a friend, to whom they were addressed in answer to inquiries concerning the efficiency of these motors.

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* Now if we suppose that under the usual practical circumstances, we can only realize a force equal to lifting two-thirds of the power applied to an overshot wheel, we have then $788 \times \frac{2}{3} = 525$ cubic feet. Then an available work of $525 \times 62\frac{1}{2} = 32{,}812$ lbs. raised one foot high per minute, *or one horse power of Boulton and Watt's steam standard, will grind and drsss one bushel of wheat per hour;* which is easily remembered, and is undoubtedly *a safe practical rule,* erring probably in excess, rather than otherwise, when the mill is well constructed and properly managed.

The letters of this gentleman—who had used a number of reaction water wheels in his mills, who possessed the patent right of one of the best of them, and who was, therefore, pecuniarily interested in their success;—breathe a most admirable spirit of candor and intelligence, and seem to be decisive upon the point, *that reaction water wheels are not economical in the use of water;* though he finally adheres to the opinion, (correct beyond any doubt) that they are superior to ordinary breast wheels, when flooded by backwater.

May 14*th*, 1833.—This intelligent manufacturer states,—that at one of his mill sites, where the head and fall is five and a half feet, *and very liable to backwater*, after trying several reaction wheels, and being well satisfied with them, he was about to take out a breast wheel of eighteen feet long and nine feet diameter, with straight floats, and substitute a reaction wheel of cast iron. The whole tenor of this letter is favorable to reaction wheels, though he says with candor, that he is unwilling to express the opinion that where there is no backwater the reaction wheels will do more work with the same amount of water than a good breast wheel can perform.

July 20*th*, 1833.—The same gentleman says he fears that he was too sanguine in his former letter—that three of the new reaction wheels put in action at one of his mills, which were expected to carry 2000 spindles, have proved to be able to carry but 1200—that these wheels consume a great deal of water, and yield but little power in return—that he must get the patentee to see if any thing is wrong—that if they do not perform better he must return to the breast wheel, and use them only as auxiliaries, and finally, "*that reacting wheels are only valuable in backwater, and where there can be no possible want of water to supply them.*"

August 17*th*, 1835.—The same gentleman, after nearly four years experience in the use of reaction water wheels of the most approved pattern, states, as a summary of his practice, that:

"In backwater they are unsurpassed by any other wheel within my knowledge, for the simple reason that they will run under such head as remains, and running horizontally, and not lifting from the water, expend no power, as float wheels do, in rising out of backwater. But the power of these wheels depends, like others, upon the head under which they act, and when that head is lessened by backwater, their power is proportionally diminished. I have been each year *supplying the place of these wheels* (the reaction) *with the straight float* (breast wheel) and am now putting in two of the *latter* at one of my mills. The reason is that *the reaction wheels used the water to too great waste, and were continually out of order.* I own the patent right for a reaction wheel,* and have a half dozen on hand for which I have no use. I have also one of Wing's out of use, and of no value to me."

The above recital of the experience of an intelligent, practical man, in the use of these wheels at a site *affected by backwater*, and, therefore, the better suited to develope their peculiar advantages, is, in consequence of his being personally interested in their success, worthy of particular notice, as clearly displaying, firstly, the approval of reaction water wheels; secondly, their trial and doubts of their utility, and finally, their repudiation; which—as though a fondness for these motors was a disease with fixed symptoms and a crisis—are the same stages of opinion that others, who tried them, have passed through in several cases known to the writer; where breast wheels were eagerly discarded for reaction wheels, which, on full and fair trial, were still more eagerly repudiated, to reinstate, the formerly rejected breast wheels.

From a letter addressed by another manufacturer, (located in a different quarter of the country) to the same gentleman whose kindness has supplied us with the above, the following is extracted.

July 14*th*, 1836.—"The patentees of a reaction wheel offered to put one in for me, that should drive a certain number of throstle spindles, and other machinery *named*, with a certain quantity of water, *also named*, for a stipulated price; and if the wheel when finished would not drive all the machinery mentioned, they should have nothing for putting it in. I accepted their offer, and we entered into a written agreement; they put in the wheel, but they could not make it drive all the machinery they engaged it should, although they used *more water* than was agreed upon. This wheel is geared into the same upright shaft with the breast wheel I had previously put in, which afforded a fair opportunity of testing the power of the wheels; I therefore threw the breast wheel out of gear, and put as much machinery on the *reaction wheel* as it would drive at speed, *and measured the water it was using;* I then put the *breast wheel* in gear, drew water enough on it to make it drive the same machinery, at the same speed it was driven by the reaction wheel, *and measured the water as before*, the difference was considerably in favour of the breast wheel certainly, and if the measurement of the water was correct, *it was quite* 20 *per cent.*"

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* This wheel was regarded as one of the very best of the species, all of which are remarkably similar, as we have before stated.

This *direct* comparison of the work of reaction and breast wheels, made upon a large scale, and under precisely the same circumstances, appears to be absolutely decisive that the former are inferior to the latter, as an hydraulic motor, when the question of *backwater* is left out of view.

Now the ratio of power to effect which commonly obtains in breast wheels, as employed in this country, is about 10 to 5, or their co-efficient of effect may be taken at 0.500; hence if the breast wheel requires, as stated above, 20 per cent. less water to produce the same effect than the reaction wheel did, we have the following proportion to find the co-efficient of the latter, viz:

$$12\tfrac{1}{2} : 10 : : 0.500 : 0.400.$$

From trial by this manufacturer then, it seems that the co-efficient of effect of reaction water wheels is about 0.400; by our own experiment its value must have been near 0.400, by the experience of the other manufacturer cited, it is clear that it must have been considerably less with his reaction wheels than 0.500, and, finally, by Mr. Waring's investigation, that it was only equal to the undershot co-efficient.

In consequence of all this, we are induced from the information at present in possession, and from some personal observations, to form the opinion, that at least, where they are actuated by a clear fall of water unimpeded below, *the ratio of effect to power in reaction water wheels, is not higher than in good undershot wheels, under the same circumstances.*

If this conclusion is correct (and *if not*, we hope the contrary will be experimentally shown by some of the numerous readers of this journal, who are competent to such researches) it is truly surprising that proprietors of works driven by overshot wheels, with a fine fall, should ever, in any case, have resorted to the use of these *water consumers;* as has been done, to some extent, at the government works at Harper's Ferry, and at a few other points, known to the writer, where *overshot wheels* have been removed to make way for those of *reaction!* which it would appear from the above remarks, *consume twice as much water to produce a given effect, or as much as undershot wheels usually do.*

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cost of Transportation on Railroads. *By* C. Ellet, Jr., *C. E.*

[CONTINUED FROM PAGE 147.]

On the Value of Gradients. In the preceding number I proposed a formula for the determination of the cost of transportation on railroads. I am aware that that expression is not in accordance with the opinion which now prevails in regard to the economy of railroad conveyance; and that there are many gentlemen of experience and reputation who are prepared to adopt a much lower estimate than mine. But, until some road can be adduced on which the experiment has been tried long enough to exhibit a result which can be received as a fair average, and which authorizes lower constants, I cannot consent to the reduction of the formula. In its present state it gives a measure below the actual performance on any road in the United States.

I am also aware that, in not presenting the average cost of freight in any particular number of cents per ton per mile; or in any particular sum per mile traveled by the locomotive engines, I have deviated from the popular and most approved methods of treating the subject. But I regard the aggregate cost per mile run as no guide whatever to the economy which characterizes the management of a railroad; and deem it an unauthorized assumption that because this sum is, in any instance, unusually low, the work is conducted with more than ordinary success. The fact, where it exists, can only be used to prove, if other circumstances remain the same, that the engines have taken smaller loads, and made a greater number of trips, and run more miles, than was absolutely necessary. In fact, if we admit, what cannot well be denied—that under similar circumstances, and with engines of the same class, the cost of locomotive power is proportional to the distance run—or that the cost of running one mile is not *diminished* by *increasing* the load, it follows as a consequence that, *cæteris paribus, the more economical the administration of a road, the greater will be the aggregate cost per mile run by the locomotive engines.*

Neither is the circumstance that the aggregate expenses of a line for one year divided by the number of tons conveyed, exhibits a low average per ton per mile, any test of good management. The fact, by itself, is more likely to prove that the tonnage was great than that the administration was judicious.

I shall now proceed to deduce from this general expression of the cost of freight, certain consequences of the utmost importance in the location and establishment of railroad lines, which I believe have hitherto been little, if at all, regarded.

What is the Value of Gradients? I mean by this question, how much more is a railroad having gradients of thirty feet per mile worth than the same road with grades of forty feet per mile? Or, how much money would good economy authorize an engineer to expend, in the construction of his road, in order to reduce the limiting gradient any given amount?

I have seen various intricate and laborious solutions of questions which involve the loss of *time* and the consumption of *steam* in the ascent of gradients; but I have never yet met with any examination of this interesting and all important problem. The loss of *time*, in this country, is usually a matter of little consequence in the transportation of merchandize; and experience teaches that the cost of motive power is very nearly proportional to the distance traveled by the engine, and very little affected, within the limits which ordinarily occur in practice, by irregularities in the tractile power. It is no doubt true that if we were to make observations under extreme circumstances —as where the engines move on a perfect level, and where they frequently mount the steepest grades they can possibly ascend without loads—the cost of motive power per mile run, would be found to exhibit very considerable variations. The charges for fuel, as well as for repairs, would be materially increased by the increase of the acclivity of the grades. But we have no such extreme cases in practice; and the following investigation is based on the authorized assumption that the cost of running the locomotive engine and its tender, without other load, is proportional to the distance run, and independent of variations of the tractile force consequent on the ordinary irregularities of grade.

In the preceding number, the aggregate annual expenses of a line of railroad under good management were represented by this formula,

$$\frac{3\,N}{10}+\frac{14\,T}{1000}+500h, \qquad (A)$$

In which N is put for the number of miles traveled, during the year, by the locomotive engines, T the number of tons net carried one mile, and h for the length of the line.

This formula, it will be observed, expresses the cost of transportation without any express computation of the effect of the grades over which the tonnage is carried. Nevertheless, the result which it yields is not independent of the grades; for they enter into the value of N, and control the number of miles traveled by the engines. The variation of the maximum gradient will not cause a sensible variation of any item of the aggregate cost of transportation excepting that of the locomotive power.

Now, in deducing the changes in the cost of locomotive power consequent on changes of grade, I shall assume that the circumstances of the trade are such as will permit that the machine be always started with a full train—that is to say, with the largest train which it is certain to control on the limiting grade. In many instances this assumption is not strictly in accordance with the facts; since it is frequently advisable—particularly where the grades are light, and the trade inconsiderable—to effect a portion of the transportation with imperfect loads. In such cases greater ascents might obviously be encountered without increasing the cost of carrying every train; and the effect of assuming that the trains are all full, when a portion of them is not full, will evidently be, to render the estimated increase of cost consequent on the gradient somewhat higher than it really is.

The formula is intended to fix *a limit* within which the actual value of the grade must always be found; and as it should be the object of every company to do their transportation with the least possible labour, and at the least possible cost, the number of miles actually traveled ought to approach very nearly the number corresponding with the assumption of full trains; and consequently, except in extreme cases, the estimate should not be much in excess. But if the situation and circumstances of the line be such as will preclude the probability of loading all the tonnage trains to the proper limit, some allowance may be made, in the application of the formula, for that portion of the trade which it does not embrace.

Now, if the limiting gradient of the road be changed, the number of miles traveled by the locomotive engines will also be changed. If the load be reduced one half by the introduction of any plane, the number of trips, and, consequently, the cost of locomotive power, will be very nearly doubled by the admission of that plane.

But the number of miles traveled by the engines in the course of a year, supposing them to convey full loads, and the transportation, accordingly, to be effected with the greatest possible economy of power, will be expressed by

$$\frac{2\,T'}{n} = N,$$

Where n is put for the average gross load in tons, up the limiting grade, and T' for the gross weight in tons carried in full trains one mile in the direction to which that gradient is opposed.

We know, from satisfactory experiments, that an inclination of twenty feet per mile, on a road in good adjustment, requires for its ascent a power nearly double; and one forty feet per mile a power treble, and one of sixty feet a power quadruple (or, for grades under eighty feet, very nearly in this proportion) that which is required to draw the same weight on a level. In other words, if W be the gross load an engine is capable of drawing with safety and certainty on a level road, and x the inclination, in feet per mile, of the gradient which limits the load, then

$$\frac{20}{20+x}W=n$$

will be the load, near enough for our object, with which it can mount the plane ascending x feet in a mile.

If we now designate by C the cost of running the engine with its tender only, one mile; by c the additional cost of motive power per mile, due to each ton gross added to the load—then $C+cn$ will be the whole cost of motive power per mile run. This sum may be written

$$C+c\frac{20\,W}{20+x},$$

by substituting for n its value expressed in terms of the grade and the power of the engine.

If we now multiply this sum by $2\,T'\,\frac{20+x}{20\,W}$, the number of miles that ought to be traveled by all the engines in the course of a year, we shall obtain for the whole annual expense of motive power

$$2\,T'\left(C\frac{20+x}{20\,W}+c\right),$$

and for the whole annual cost of maintaining the line and transmitting the trade which it receives

$$2\,T'\left(C\frac{20+x}{20\,W}+c\right)+\frac{14\,T}{1000}+500\,h; \qquad (B)$$

in which we have the aggregate cost of transportation, with the greatest attainable economy of power, cleared of the number of miles traveled by the engine, and expressed in terms of the particular grade which controls the cost of power.

In order to determine the sum which we might expend for the reduction of this limiting gradient, which is the problem under consideration, we must ascertain the value of this formula for different values of x, and take the difference between those values.

If we now suppose x to assume the new value x', the corresponding difference produced in the aggregrate annual expenses by the change of gradient, supposing still that the trains are full, will be

$$2\,C\,\frac{x'-x}{20\,W}T'. \qquad (C)$$

The increase of expenses is proportional to the increase of the sine of the angle of inclination of the gradient; and directly proportional to the gross tonnage which ascends the limiting grade, in full trains, and reciprocally as the power of the engine capable of running one mile at the assumed cost of locomotive power.

The value of gradients, or the expenses which they produce on railroad lines, will diminish, therefore, proportionally to the improvement in the power of the engines.

Let us now substitute for C its value—three-tenths of a dollar—and put $x'—x=1$; and we shall obtain

$$\frac{3\,T'}{100\,W} \qquad (D)$$

for the increase of the annual expenses of a road consequent on the addition of one foot per mile to the acclivity of the limiting slope.

It is not easy to assign the proper measure of the average power of the freight engines now in use; but if we assume 300 tons gross for the maximum load on a level at all seasons of the year, of engines of the medium class—from ten to twelve tons weight—we shall not be too low for the present condition of the machine, and the average power of all good engines of that class.

With this addition to the *data* of the problem, we shall have

$$\frac{T'}{10000} \qquad (E)$$

for the annual value, in dollars, of one foot in the acclivity of the maximum, or limiting, gradient.

If we now capitalize this quantity, or determine from it the original outlay of capital which would be justifiable in order to avoid an increase in the ascent of *one foot per mile*, we shall find it to be

$$\frac{1}{600} \text{ of a dollar,} \qquad (F)$$

or $1\frac{2}{3}$ *mills for each gross ton carried one mile*—the value of money being taken at 6 per cent.

In other words, to find the value of any reduction of the acclivity of the limiting grade, on ordinary railroads,

We multiply the number of tons gross carried up that grade in full trains by the length of the line (or by the distance run by the engines which cross the grade in question,) *and by the number of feet per mile in the ascent which it is proposed to save, and divide by* 600. The result will be the value of the reduction of the grade, in dollars.

There is one point in this annunciation, worthy of remark, and which I believe is never regarded in the consideration of such subjects —if indeed this question itself has ever received any consideration. The amount which may be paid, or ought to be expended, for the reduction of the maximum grade, *is proportional to the length of the road*, if the engines run "through;" or proportional to the length of the "stage" on which the gradient is found, if the line be very long and divided into stages. And this law will continue to apply until it becomes more economical to employ one or more assistant engine to aid in the ascent of such grades; in which case the value of these auxiliary engines, or the expenses which they involve, limits the sum which may be expended in the reduction of the acclivity.

For the purpose of an application of the rule which I have announced, let us suppose that the road is thirty miles in length; that the duty to be exacted of the engines is equivalent to 20,000 tons gross conveyed "through" in the direction to which the limiting gradient is opposed; and that the cheapest admissable line would present a gradient of fifty feet per mile. How much could we afford to expend, in the construction of the road, in order to reduce this limit to forty feet? By the formula (F) we have

$$\frac{20{,}000 \times 30 \times 10}{600} = \$\,10{,}000.$$

The comparison of this result with the cost which would be actually required, under the circumstances, controls the location. But if the trade in this case had been assumed at 200,000 gross tons, and the length of the line sixty miles, the value of ten feet per mile in the limiting gradient would have been

$$\frac{200{,}000 \times 60 \times 10}{600} = \$\,200{,}000.$$

The magnitude of this last result would, of course, bring up the question of the relative economy of auxiliary power, which would be wholly inadmissible in the former case. Should the comparison determine in favour of assistant engines for the limiting gradient, our equation would then become applicable again to the determination of the value of the next highest gradient, or the sum which might be expended in its reduction.

(To be continued.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Further Notice of the Projected Water Works at Albany.

Mr. Cushman's letter, inserted in the last number of this journal, in which he declares himself "rather pleased the plan should have met with opposition," induces us to offer a few more remarks, with the view of reinforcing some of the positions taken in a review of these proposed works, inserted in the June number.

We will merely premise by saying, that if we have at all *misconstrued* the nature of the plans proposed, it was certainly unintentional, and may probably be owing to the ambiguity of the style in which they were described; of which we could offer examples if mere verbal criticism had any place among our objects.

Whether we have, or have not, *misconceived*, "*what really are the* *results of practice,*" as is alleged, we freely leave to the decision of our practical readers, most of whom are perfectly cognizant of the facts, upon which our former observations were grounded.

For the sake of convenience, we will still observe the same numerical order, in those of the few paragraphs concerning which further observations are offered, as was observed in the former review, and followed in the letter inserted in the last number.

I. *Concerning the proposed Street Jets for Extinguishing Fires in Albany.*

Mr. Cushman (at page four of the printed report forwarded to the Institute) says "for the extinguishment of fires, *effectually and expeditiously, without other power than that derived from the head of water,* it will be necessary to command a greater head than would suffice to deliver water upon the roofs by a hose or conduit pipe reaching to the roof itself."—"It should be great enough to force upon the roof a *jet d'eau* by means of a short hose applied to the hydrant, &c.," and upon page 5 of the report, he further says, "*an additional ten feet,* at the fountain, will enable us to accomplish this important purpose, *as perfectly as is possible by any exertion of power, &c.*"

Now the parts of the above extracts, which we have taken the liberty of *italicising,* show clearly enough; *first,* a design to dispense entirely with fire engines! and *second,* an expectation that jets through hose from the streets, will rise within ten feet of the altitude of the head of water which actuates them, (or height to which the water would rise in a standing pipe,) that head being either fifty-five feet, "*within the city limits,*" or near 260 feet "*in the lower part of the city,*" according as we take *the report,* or *the letter* as authority!

It was to combat these apparently erroneous doctrines, that we advanced the case of the jet d'eau at Fairmount, which from what information we then had, was supposed to play only about thirty feet under a head of nearly eighty feet; since then, by the aid of a good theodolite, we have ascertained that when the full opening is drawn, of all its cocks, this jet, actuated by seventy-five feet head, rises forty-five feet high into the air, or falls thirty feet short of the level of the reservoir.

All that we alleged, however, in the former review, viz. that although this fountain is under very favourable circumstances for producing a high ascension of water, yet "*such a jet as might have been expected does not result,*" is still borne out, by the accurate measurements recently made; for (not to multiply authorities) we find by resorting, for example, to Professor Renwick's Treatise on Mechanics that the altitude of this jet, if deduced from the formula there given, viz:

$$H=\frac{h^2}{360}+h$$

—where H = the head of water above the ajutage, and h = the height of the jet—*should be* sixty-four feet for a head of seventy-five feet—*it is* really but forty-five feet, the practical defect being nineteen feet. Were we not justified then in saying that its altitude is less than "*might have been expected?*" And will not the jets at Albany probably fall short as much?

In fact we might, with apparent safety, infer that the *street jets* at Albany, will fall still more short of the altitude of their active head, than does the one at Fairmount; for it must not be overlooked, that although the form of the ajutage of the latter is not the most favorable possible, for producing the highest projection of water, it is yet more so than the common branch pipe of a hose, as will be readily appreciated.

Again it is perfectly well known here, that notwithstanding the abundance of our usual supply of water, whenever a great fire breaks out, and the fire department have made their attachments to the fire plugs, it is with the greatest difficulty that any water can be procured from the private hydrants in the vicinity, though these are but little elevated above the pavement, and usually about sixty feet below the level of the surface of the reservoirs at Fairmount; and we may further mention, that the ordinary consumption of the city, prevents the water from rising, in *a standing pipe*, at the Navy Yard, on the Delaware front, within nearer than about fourteen feet of the reservoir level; now if projected from the pavement by a hose, it would of course fall much more short—probably, indeed, forty feet short in all—and as the usual city supply must go on at all times when it is required, how can only ten feet additional head be expected to control fires by *street jets?*

Of course isolated cases will, and do sometimes, occur, when a single hose attached *promptly*, may subdue a fire in its inchoative state; but they are not common, and it would certainly never answer, to rest the safety of a large city upon the possible contingency of attacking every fire, in its very inception; an apparatus must therefore be kept, and a department organized, capable of making head against, and extinguishing, a considerable conflagration; and being so kept, and always ready to act, the occasional importance of a single jet, dwindles into insignificance; or even vanishes entirely.

Mr Cushman, in his letter p. 147, in speaking of the fountain at

Fairmount, says: "Now the *essential circumstance* of the trial having been made with a single ajutage of *one inch* in diameter, has been entirely overlooked, while it is 'a stubborn fact' that with a plentiful supply of water and given height of fountain, *the height of the jet may be increased* through *a very great range,* simply by varying the size of the orifice of the ajutage. My plan had due reference to this appropriate orifice for the jet, and the writer's opposition to it arises from a want of knowledge of any such requirement."

Upon this very point in Cavallo's Philosophy, p. 221, 4th Am. Ed., we find the following remarks.

"By enlarging the aperture the friction against the sides is diminished, but the friction or opposition of the air is increased. Therefore as long as the former is diminished faster than the latter is increased, the jet may be made to ascend higher and higher, by enlarging the aperture; but beyond that limit, the enlargement of the aperture will not increase the height of the jet. Now it has been found *from a variety of experiments,* that this limit, or maximum of effect, takes place when the diameter of the circular aperture *is somewhat less than an inch and a quarter."*

Now as it seems absurd to suppose that to produce *"a very great range,"* in speaking of a *one inch* jet, Mr. Cushman intended only *one quarter of an inch* variation in the size of the orifice of the ajutage, and as Mr. Cavallo explicitly declares, in the above extract, that the ajutage of a jet of maximum altitude, with a given head, *requires* to be one and a quarter inch *only,* we are impelled to the conclusion that the phrase *"very great range, &c.,"* could only have been used in this connexion, from *"a want of knowledge of any such requirement."*

Be this as it may, we *did not* mistake the "individual fact" at Fairmount for *"a principle,"* as is alleged, but merely regarded it as *an instructive example, pregnant with meaning;* hence we feel but little interest in this part of the discussion, and leaving Mr. Cushman to settle with Mr. Cavallo the question of variation in the size of the ajutage, and the extent of range through which jets may thereby be augmented in altitude, we will now pass to other points.

III. *Of the thickness of Cast Iron Conduit Pipes.*

In commenting upon this subject in our review, we referred to the fact, that *long practice* had established the necessity of giving to conduit pipes, a thickness *very much greater* than would be deduced by a mere calculation, based, in any given case, upon the known working pressure of water, the known tenacity of cast iron, and perhaps a small addition for corrosion.

In our review we attempted, upon sheer practical grounds, to combat the fatal doctrine, that "one-twentieth of an inch is amply sufficient to sustain the pressure resulting from a head of fifty-five feet," even if subsequently proposed (on account of probable corrosion) to be augmented fivefold, or only to *one-fourth of an inch in thickness,* for cast iron conduits of seventeen inches calibre, working under fifty-five feet head!

Far from regarding such pipes as possessing so large a surplus of substance that "we may certainly rely upon the efficiency and durability of the conduit" if working under fifty-five feet head; we were impelled to conclude from practice here, that such a conduit would *necessarily fail* to realize the expectations formed of its utility.

For it is to guard against contingencies from without, as well as the pressure from within, that experience has shown a thickness of *two-thirds of an inch,* to be indispensable for our water pipes of sixteen inches calibre, working in the general plane of the city, under a pressure about the same as is proposed at Albany; amongst the chief of these contingencies may be named the settlement of the earth above them, in which they are buried; it would appear that the hubs, or projections, at the end of each nine feet length of the conduit pipes, rest usually upon a solid foundation formed of undisturbed earth, whilst the body of the pipe often scarcely touches at all, it being very difficult so to pack the earth around, and below it, as to secure an uniform bearing.

To show what great errors we should fall into, by founding an estimate of the necessary thickness of conduit pipes upon a mere calculation of the pressure within them, we will refer to the case of the gas pipes of Philadelphia, which work under a pressure equivalent only *to three inches head of water;* now these pipes, if proportioned to the pressure within, upon the supposition that "one-twentieth of an inch is amply sufficient" to sustain a head of fifty-five feet (as stated on p. 15 of the printed report) would scarcely be thicker than this sheet of paper! Let us inquire what is the actual thickness in use in Philadelphia? The able superintendent of the gas works has informed the writer, that their sixteen inch mains are made about five-eighths of an inch thick, and that, as a general rule, they give to the gas conduits *only ten per cent. less substance than practice has assigned to those of similar calibre which convey water through the city.*

Such being the case here, we invite our readers to calculate the minute fraction of an inch, which would represent the thickness of cast iron gas pipes, upon the supposition that *the pressure alone* should be regarded, and ask themselves whether such attenuated tubes could be, for a moment, thought of *for actual use;* for we may probably be told that the thickness commonly allowed for gas pipes *every where*, which far exceeds what the mere pressure within would require, is one of the "errors of practice" that ought to be repudiated; though such an allegation would more likely be regarded by impartial people as *an error* in him who ventured the assertion.

V. *Concerning the separate lengths of the Conduit Pipes.*

The fact that in practice the hubs of pipes are likely to, and do often actually, become fixed points of support, is a very strong argument (amongst others) against increasing their length from nine to fifteen feet; more especially, when at the very same time that it is proposed to increase the lengths of the pipes, and thus essentially augment the stress upon them; it is also (most singularly) proposed, greatly to reduce the thickness assigned them by practice, so as very much to diminish their ability *to support that augmented strain!*

VII. *Concerning the velocity of the water in the main rising from the pumps.*

The writer has been informed on good authority, that soon after the present works at Fairmount were first put in operation, numerous experiments were made with the view of determining the most advantageous velocity at which to work the wheels and forcing pumps; these trials were commenced with about fifteen revolutions per minute of the wheel, when driving the double forcing pump with five feet stroke each way, or with a velocity of water in the rising main of 150 feet per minute; at which speed every thing worked smoothly and well; but as this celerity gave to the wheel, at the skirt, a velocity of nearly twelve feet per second, it was thought desirable to diminish it; and accordingly trials were made, by reducing the motion successively, one revolution at a time, until the number of turns of the wheel in a minute was reduced to twelve, or the speed in the rising main to 120 feet per minute; *still all worked well*, and so continued until the speed was somewhat further reduced; but it was soon after discovered that during the instants of time, when the piston was changing its direction at either end of the pump barrel, a recoil of the ascending column began to take place at these intervals; *owing to the momentum not being kept up whilst the piston cleared its dead points;* and when the speed was reduced as low as eight turns of the wheel in a minute, or the ascending rate to a velocity of eighty feet per minute, (still fifteen feet per minute *greater* than is proposed at Albany,) the recoil at each end of every stroke of the force pump, became so serious as to cause the shocks to be very perceptible, like the pulsations of an hydraulic ram, the joints of the pump began to open and leak, and the successive shocks threatening to blow up the working tube, the experiments were discontinued by the superintendent; he having satisfied himself *that a velocity of about* 120 *feet per minute for the water in the rising main,* was, in view of every thing, the most suitable speed at which to operate these works.

This is not a *theoretical* conclusion, but *an experimental result* of a very significant character; one that will neither be misunderstood, nor disregarded, by any practical man who feels a proper anxiety for the success of works committed to his charge; and we submit, whether it does not entirely justify the remarks formerly made by us upon this point.

Finally, being quite content to rest the case, in connexion with the other points mentioned in our review in the June number, upon the issues made upon the arguments formerly advanced, and having already occupied, with these remarks, much more space than had been originally designed, we will now take a final leave of the subject by expressing the hope, that before the "Projected Water Works at Albany" are put in hand for execution, *the plan* may be more maturely considered by the respected engineer, lest in after times some future projector of water works, may point to them as instructive examples of "*the errors of practice.*" M.

Facts and Observations on Four and Six Wheel Engines. By John Herapath, Esq.

[CONTINUED FROM PAGE 160.]

Glasgow and Ayr Railway.—This is one of the lines upon which I was unable to go, but respecting the locomotives of which, however, I have been favoured with some information. The total length of this line is forty miles, as it appears from an article on the Glasgow and Ayr Railway, in the 35th No. of the octavo series of the R. M.; that is, seven miles from Glasgow to Paisley, ten to Johnstone, fifteen to Lochwinnoch, nineteen to Beith, twenty to Kilburnie, twenty-three to Dalby, twenty-nine to Kilwinning, thirty to Irvine, thirty-three to Troon, and forty to Ayr. The present amount expended is something under £ 20,000 per mile.

The steepest gradient of this line is eleven and three-fourths feet a mile, and there is no sharper curve than a mile radius, except at the Glasgow terminus, where it is 1200 feet. For the curve of a mile radius the outer rail is elevated three-fourths of an inch. The locomotive stock of the Glasgow and Ayr Railway, consists of twenty engines; eight made upon Mr. Bury's plan, that is four wheel engines, with inside bearings, and the other twelve are made upon the plan of the Company's Engineer, Mr. Miller. These are six wheel engines, and have inside bearings. The weight of the six wheel is thirteen and a half tons; their weight on the driving wheels is six tons, (query, seven tons) and on the other wheels three and a quarter tons each.

The weight of the uncoupled four wheels is ten tons, and of the only two coupled engines they appear to have, thirteen tons, of which the weight on the driving wheels of the uncoupled four wheels is six tons, and on the other wheels four tons. In the coupled engines the weight is equally distributed.

Of these engines nineteen are in a fit state to leave the station with a train, and the twentieth one, at the end of November last, was expected to be ready in a few days. The driving wheels on the six wheel engines have flanches seven-eighths of an inch deep.

The motion of the coupled engines is less than those four wheel that are not coupled, but it is not thought they have sufficient experience in these matters to speak as to the particular safety or danger of either kind.

From August twelve months, the time the line was opened from Glasgow to Ayr, they have not had more than three detentions on account of derangement of machinery. In neither of these cases was the engine thrown off the line, the detention having been from some very slight breakage in the machinery, or the pumps being out of order, nor has there been any, the slightest, accident to carriages or passengers.

There have been no broken axles whatever.

From the time of the opening to Glasgow, three engines have been thrown off the rails, at the switches near the stopping places, or stations. Two on account of the switchmen having pointed the rails wrong as the engine was entering the station, and the other on account of the connecting rod of the two switch bars having got too much play. In no instance has any damage been done to any passenger, or servant of the Company, or to any carriage. These accidents happened, one with a six wheel engine, and two with a four wheel, all uncoupled. All the driving wheels are five and a half feet diameter, except the two coupled engines, which are five feet. They have thirteen inch cylinders, eighteen inch stroke. The gauge of the rails is four feet eight and a half inches, and the play of the wheels on the rails is half an inch, and the pressure per square inch fifty pounds. The average cost of the six wheel engines is £ 1,320, and of the four wheel £ 1,400. They find the four wheel engines more economical in point of consumption of coke, but in no other respect do they conceive that one kind of engine has any advantage over another. The six wheel consumes forty-two pounds of coke per mile, and eighteen gallons of water; the four wheel forty pounds of coke per mile, and sixteen gallons of water.

Motion is said to be more conspicuous in their four wheel engines than in their six. The four wheel has a slight vertical motion, the six wheel a slight lateral motion, but the engines run so very steadily that motion is scarcely perceptible. These motions, however, whatever they are, they think are due chiefly to the imperfections of the road. The length of their six wheel engines is eighteen feet, and of their four wheel sixteen feet. They have no practical proof that the distance of the cranks from the middle of their axles produces any sinuous or sidling motion. Total mileage per annum is 130,000.

Maryport and Carlisle Railway.—Though I had a very kind invitation from William Mitchell, Esq., the Secretary, I was, for the same reasons as stated in my account of the Great North of England, Glasgow and Ayr, and Ulster Railways, unable to visit this line, which was partially opened July 15, 1830.

They have only two locomotive engines, six wheel and outside bearings. One, a coupled engine, fifteen tons, and the other, an uncoupled, thirteen tons. The coupled engine has about half the weight on the driving wheels, and the uncoupled about ten tons. One of these I understand to be coupled in all six wheels. They find it a safe engine, but the uncoupled one is of little use, for the heavy loads which they carry, namely, 140 tons. The coupled engine has flanches, and the uncoupled has not. One of these engines in November was in a fit state to take a train. They have had no detentions from failure of machinery, nor any broken crank axles, or runnings off the line. The diameter of the driving wheels of the uncoupled engines is five feet, of the coupled four and a half, the other wheels being three and a half feet in diameter. The uncoupled engine has a twelve inch cylinder, and eighteen inch stroke, the other a fourteen inch cylinder and sixteen inch stroke. The smaller engine cost £ 1,400, its tender £ 180. The larger engine and tender £ 1,720. They say the six wheel engine runs smoother on the rough road, but the four wheel takes the curves better. The average consumption of coke is sixty-seven pounds per mile, and the evaporation of water twenty-five gallons. They attribute the motions of the engines to bad road. One engine is rather top-heavy from having a high fire box. The extreme length of the engines is sixteen feet. The manager of the locomotives thinks that the distance of the cranks from the centre of the axle produces sinuous motion when the road is slippery, and much more in the uncoupled than in the coupled engine. The steam pressure is fifty-two pounds to the inch. The total distance run is 7,200 miles a year. The steepest gradient in the eight miles now opened is nineteen and one-third feet a mile, and on the part to be opened twenty-five and one-fourth feet.

At one time there was a curve on this line near the terminus of six chains radius, and with an elevation of the outer rail of only half an inch. The present secretary, Mr. Mitchell, reduced the curvature to nine chains radius, and elevated the outer rail to two inches. It is worthy of remark, that on the former curve the engine is described as having great sinuous or eel-like motion, which is now almost entirely obviated on the new curve. This is rather a curious circumstance, as I should have expected that on the curve with a larger radius the sinuous motion would have been more conspicuous. It is, therefore, a question for inquiry, whether the greater elevation of the outer rail has any thing to do with steadying the motion; for it is generally understood that the sole object of the elevation of the outer rail is to balance the centrifugal force.

I understand that the engine has often traversed this curve at the rate of twenty-two miles an hour, with a load of sixty tons after it.

The Ulster Railway.—This was another line upon which of course

I had no opportunity of going, as I did not go out of England. The length opened of this line is twenty miles.

The Company's stock consists of seven engines, all six wheel and uncoupled, with outside and inside bearings on the crank axle. They weigh sixteen tons, of which nine and a half tons are upon the driving wheels. The driving wheels have all flanches, and the whole seven of the Company's engines are in an efficient state of repair. They have had about six detentions of trains, from trifling derangements of the machinery, in two and a quarter years, but no broken crank axles, nor have they had any engine run off the line.

The average cost of their engines is £ 1,500, and of the tender £ 260. Their consumption of coke is thirty-five pounds per mile, and of water twenty-five gallons per mile. The engines are described as perfectly steady. Top-heavy engines are unknown to them.

They have no practical proofs of the influence of the distance of the cylinders from the main axis of the engine producing any effect upon the motion of the engines. The expense of repairs is 11½d. per mile per annum, and the steam pressure is sixty pounds to the inch. The gross average load is from fifty to sixty tons.

York and North Midland Railway.—As a continuation of the main trunk to the north, the York and North Midland Railway forms an important link. Starting from the junction of the North Midland and Manchester and Leeds Railways at Normanton, about ten miles south of Leeds, it pursues a north easterly course to York, crossing the Leeds and Selby Railway about fourteen miles from York, the whole length of the line being twenty-three miles fifty-two chains, or nearly twenty-three and three-fourths miles.

I have already referred, in my account of the Hull and Selby, to some of the engines of this Company upon which I have traveled. Most of them are built by Mr. Robert Stephenson. The two I traveled on with Mr. Cabrey were the *Princess* and the *Victoria.* The latter was a lively and smart engine, and in my opinion better than the former, which I thought somewhat sluggish.

The Company's stock of engines in the middle of January last was thirty-two, eleven of which were taken from the Leeds and Selby Railway when this Company became lessees of that line. The whole are on six wheels, with outside and inside bearings, except the *Prince of Wales,* the late improved patented engine of Mr. R. Stephenson. The weight of the smallest engines is twelve and a half tons. Some are between that and fourteen tons, and others are sixteen tons weight. About one-half the total weight is on the driving wheels, five-sixteenths on the fore-wheels, and the remainder on the hind wheels. They have eight coupled engines, all on six wheels, which work well, are considered safe, and not expensive, considering the loads they take. They are used exclusively for luggage trains. *Most of the engines are without flanches on the driving wheels.* Out of their number they had twenty-six in good working order, and have not averaged one detention a month from any derangement of the engines. In two years and seven months they have had *ten crank axles broken,* none of the engines being able to proceed with the train after the fracture. The axles had for some time been failing prior to the breaking down, which was attributed to their being too weak, and in some cases to the material being defective. There was only one of these a coupled engine. Five of them broke down near the station, while moving very slowly, and of course at a great strain; the others, while ascending an easy gradient on a slight curve. No accident or injury happened to any one. In no instance has an engine run off the rails except by the points being wrong. Three of the broken axles were five inches in diameter. The cost of the engines is from £ 1,300 to £ 1,600. They give a preference to six wheel engines, thinking them safer than four wheel. The gross average weight of the passenger trains is fifty tons, and average consumption of coke twenty-five pounds per mile, and for goods trains thirty-eight pounds. The motions observed are a slight pitching, rolling, and sinuous motions, which they say are most conspicuous in ascents, descents, and curves, and always arise from imperfection in the road, assisted at times by the wheels wearing out of truth. They have no top heavy engines, nor have they any practical proof that the distance of the cranks from the centre of the axle has any effect on the sinuous or sideling motion of the engines, but Mr. Cabrey thinks it probable that if the cylinders were outside the wheels, the sideling motion would be increased.

The steam pressure is sixty pounds per square inch. The distance run by the passenger engines during a year is 289,600 miles, and by the luggage engines 212,200. Including their main line and branches, and the Leeds and Selby which they lease, they work about forty-eight miles of railway. The oldest of the York engines is three years; some of the Leeds and Selby six years, but the engineer thinks the age of the engine does not affect its steadiness, provided the engine is in good order.

It was upon this line, if I remember rightly, that I was informed by the engineer that, whenever there were any fractures of the axles of wagons, it generally happened upon the stone blocks. They are in the habit of taking coal wagons of other parties, in the make of the axles of which, so much care is not bestowed, as if they were made for the Company, and hence, when they come to travel at a rapid rate, loaded, over their line, if they are disposed to break they almost always do it were the percussive effects are the greatest, that is, upon the stone blocks. *In fact, it appears to be generally established by experience, that stone-blocks are objectionable upon railways, and more fruitful in accidents (which they occasion from their rigidity,) than either cross sleepers, or continuous wooden bearings.*

[To be continued.]

Mr. Vignoles' Lectures on Civil Engineering, at the London University College.

[CONTINUED FROM PAGE 162.]

On Retaining Walls.

LECTURE VII.—Wednesday, January 5th, 1842, Professor Vignoles commenced by stating that he had then reached the third division of the first course, and his present lecture would be upon retaining walls. The meaning of the technical terms of "retaining" and "sustaining" walls was—when a wall was used either to support water or earth artificially put together; but when it was used to support natural earth, it was often called a "breast-work." As the term "batir" would often be made use of in that and the following lecture, he proceeded to explain that the batir was the base of a triangle, formed by the slope of the wall and perpendiculars of the other two sides—thus a battering wall was a sloping wall. The introduction of retaining walls was very ancient; in Italy there were several of great antiquity, formed of concrete, rubble, &c., and even some parts of the Great Wall of China was built in that way. Retaining walls were generally introduced at the ends of bridges, to connect the abutments of the bridge with the natural ground; but in these cases they were called "wing walls." In forming roads, retaining walls were sometimes carried along the sides of valleys—the road itself having to be cut at times along the sides of hills so precipitous, that half was embankment and half cutting. In the celebrated road formed by Napoleon across the Alps, there were many instances of work of this kind, and good lessons could be learnt from the failures which had taken place, the reasons for which were generally very apparent. In Telford's grand road through Wales, there were many instances of retaining walls, and one in particular, where the road had to pass along the side of a hill which was nearly perpendicular. The great cutting from Camdentown to Euston-square was another instance, but, from certain causes, which he very ably explained, the walls were giving way in many places. He then proceeded to lay down, by numerous diagrams, seven forms of retaining walls made use of; and pointed out, by mathematical formula and practical experiments that had been made, and which the diagrams explained, the best forms for use. In No. 1 the batir was represented as being equal on each side of the wall; in No. 2 the batir was on the side next the earth to be supported; No. 3 was a parallel batiring wall; in No. 4 the batir was next the earth, but at the bottom of the wall, No. 5, the batir was on the outside, at the top; No. 6, was a parallel and perpendicular wall, with no batir on either side; and No. 7 had the batir at the outer side of the wall, and next the earth the slope was cut in steps; these seven diagrams showed the common forms of retaining walls. The grand points to be considered, were—1st, the value of the pressure that the earth exercised against retaining walls; and, 2d, the description and dimension of the wall necessary to offer sufficient resistance to that pressure. It was found that if you take away the wall, the earth will for a short space of time retain its position, but, after exposure, it will begin with crumbling at the edges, and ultimately gain a slope so as to lie at the angle, which is called the "angle of repose;" this requires, in building retaining walls, that the angle of repose of the description of earth to be supported should be ascertained; this done, the pressure to be resisted might be calculated, and the dimensions of the wall be decided upon accordingly. Of all the descriptions of retaining walls No. 3 was the one which offered the most support with the least quantity of material, and which had, by experiments made at Dublin under the direction of Sir J. Burgoyne and the Board of Public Works of Ireland, been fully proved. The Professor then explained the nature of the several experiments, and the effects upon the walls, exemplifying them by very instructive diagrams. The attention of the students was next called to the curvilinear batir, and several very interesting cases were adduced of failure in that plan, from various causes, but principally from water. He then alluded to two or three failures of his own, and fully explained to the students the causes of them, and the means he should have adopted in the first instance for their prevention. The occasional supporting of walls was judicious in various instances; suppose there was a case, that, while the earth was in an unsettled state, the pressure against the wall was double what it would be when it had settled; in such a case he would recommend supporting walls until the settlement took place—not to go to double the expense for a temporary purpose. He then mentioned a very remarkable instance of an abutment, which was practically a retaining wall, giving way. He had to make an arch of twenty feet span for a river, through an embankment eighty feet high; the foundation was rock, but a sudden lurch took place in the body of the embankment, and the earth forced its way through very many feet of sand backing, drove the abutment or retaining wall clean off the rock, and moved the whole twelve or thirteen feet. Several good rules were then laid down to calculate the description of wall to be used, and method of giving a temporary support until the earth settled; and the learned lecturer, in conclusion, stated that his next lecture would be given on Wormwood Scrubbs, where there were some most remarkable instances of failures in retaining walls, the reason of which he could better explain on the spot than by diagrams.

On Atmospheric Railways.

Lecture VIII.—Monday, January 10th, 1842.—This being intended as a practical illustration of some interesting and important points, the lecture was delivered on the works of the railways situated at, or near, Wormwood Scrubbs, in place of being given, as usual, in the lecture room of University College.

The first point to which Mr. Vignoles directed the attention of the class was to the atmospheric railway, or rather a portion of railway laid down on that principle for experimental purposes, upon the line belonging to the West London Railway Company. The length of this experimental line is half a mile, and, according to the Professor's statement, it fully answered the purpose, and he, at some length, and with great ingenuity, explained the principles of the system. The iron tube first attracted attention; it is nine inches in diameter, with a grooved slit along the upper surface, which is closed by means of a valve of leather, strengthened by plates of iron, flat on the outside, and forming the segment of a circle on the inside, so as to complete the diameter of the tube when it is shut; at the edge of the valve is a composition of bees' wax and tallow, which renders the tube air tight.

Next was examined the carriage, to which was attached a piston, fitting into the tube, and a very ingenious contrivance was shown, by which the valve was first opened and afterwards closed down, immediately after the piston had passed, however great the velocity of the carriage. The impossibility of procuring a perfect vacuum had long been assigned as the great objection to this principle of producing locomotion; but Professor Vignoles showed that a good working half vacuum was, by the simple contrivance he had explained, quite attainable, and sufficient for practical purposes. The engine and air-pump were next severally examined and explained, and the lecturer then gave some very interesting explanations of matters connected with the present experimental railway; he stated that the air from the half mile of tube could be extracted in about one minute, while it would take nearly eight minutes for the leakage of the valve and air-tube to admit the air to fill the tube. In consequence of the imperfections in the present line, which had been merely laid down for experiment, the leakage was very much more considerable than when a perfect line should be formed for service, and the formation of a railway on the atmospheric principle would not exceed, perhaps, one-third of the cost of many of the great lines hitherto contracted for, as it would do away with much of the cutting and embankment, the slips of which had recently been so troublesome and dangerous, by the trains being able, on this method, to ascend considerable acclivities. The present experimental line had a rise of about one foot in 110, and he had gone along at the rate of forty-five miles an hour, notwithstanding the imperfections of the machinery and the wretched state of the line; he pointed out that it would be practicably impossible for a locomotive to travel upon such a line, as it would be off the rails immediately, in consequence of their being so uneven and loose; yet he had traveled at the rate he before mentioned, with perfect ease and safety; and, furthermore, the extreme simplicity of the machinery rendered it very unlikely to get out of order. A few weeks back the line was required suddenly for some experiment, and, although the tube was half full of ice, in less than half an hour every thing was in readiness, and the trial was very satisfactory. The power obtained by the present small tube is 1760 lbs., with an atmospheric pressure of about eight pounds per inch only. The engine employed to work the air-pump is sixteen or eighteen horse power, and the economy of stationary over locomotive power was admitted by every body. He concluded his remarks upon this interesting, and what promises to be most useful, application of the power of atmospheric pressure, by detailing, at some length, the minutiæ of the saving that would be effected by its general adoption, and stating that two miles were to be laid down upon the Dublin and Kingstown Railway, to try the experiment upon a larger scale, with a tube fifteen inches in diameter, and more perfect apparatus. The Professor then, as the party walked along the line, pointed out to the class various slips that had taken place, some of which were slight, and others extensive; one part in particular, situated between the Great Western and London and Birmingham Railways (which are here within a quarter of a mile of each other,) attracted general attention, the whole, for nearly 100 yards, being a perfect chaos. A remarkable instance of a failure of a retaining wall here presented itself, it having, for about forty-five yards, been actually pushed forward off the foundation, to a distance of eight or ten feet, the wall still standing, which appeared to be about four feet thick, strongly built of brick and concrete and strengthened with bands of iron and wood. The causes of this destruction were explained by Mr. Vignoles as arising from the lodgment of water, which, having no outlet, had settled the earth against the back of the retaining wall, turning the clay into mud, and, by the great additional weight, forcing it into the position in which it now appears. If the water had been cut off in time this would not have happened, and that water was the occasion of this accident seemed very apparent. The lecturer then pointed out the manner of supporting retaining walls. Several portions of the London and Birmingham and Great Western Railways were then examined, and much valuable information was given on the various contrivances made use of by these companies, and he concluded by appointing the class to meet on the Croydon and Brighton Railways the next morning, to proceed to the great slip near New Cross.

[TO BE CONTINUED.]

Physical Science.

On the Chemical Statics of Organized Beings. Extract from the concluding Lecture, in L'Ecole de Médecine in Paris. By M. DUMAS.

[CONCLUDED FROM PAGE 175.]

V. An animal, in fact, constitutes an apparatus of combustion from which carbonic acid is continually disengaged, in which, consequently, carbon undergoes combustion.

You know that we were not stopped by the expression *cold-blooded animals,* which would seem to designate some animals destitute of the property of producing heat. Iron which burns vividly in oxygen produces a heat which no one would deny; but reflection and some science are necessary in order to perceive that iron which rusts slowly in the air disengages quite as much, although its temperature does not sensibly vary. No one doubts that lighted phosphorus in burning produces a great quantity of heat. Unkindled phosphorus also burns in the air, and yet the heat which it developes in this state was for a long time disputed.

So as to animals; those which are called warm-blooded burn much carbon in a given time, and preserve a sensible excess of heat above the surrounding bodies; those which are termed cold-blooded burn much less carbon, and consequently retain so slight an excess of heat, that it becomes difficult or impossible to observe it.

But, nevertheless, reflection shows us that the most constant character of animal existence resides in this combustion of carbon, and in the development of carbonic acid which is the result of it; beginning, also, in the production of heat, which every combustion of carbon occasions.

Whether the question be of superior or inferior animals; whether this carbonic acid be exhaled from the lungs or from the skin, does not signify; it is always the same phenomenon, the same function.

At the same time that animals burn carbon, they also burn hydrogen; this is a point proved by the constant disappearance of hydrogen which takes place in their respiration.

Besides, they continually exhale azote. I insist upon this point, and principally in order to banish an illusion which I cannot but believe to be one of the most prejudicial to your studies. Some observers have admitted that there is an absorption of azote in respiration, but which never appears unaccompanied by circumstances that render it more than doubtful. The constant phenomenon is the exhalation of this gas.

We must therefore conclude with certainty, that we never borrow azote from the air; that the air is never an aliment to us; and that we merely take from it the oxygen necessary to form carbonic acid with our carbon, and water with our hydrogen.

The azote exhaled proceeds, then, from the aliments, and it originates in them entirely. This, in the general economy of nature, may in thousands of centuries be absorbed by plants which, like Jerusalem artichokes, draw their azote directly from the air.

But this is not all the azote which animals exhale. Every one gives out by the urine, on an average, as M. Lecanu has proved, 230 grains of azote a day, of azote evidently drawn from our food, like the carbon and hydrogen which are oxidised within us (que nous brûlons.)

In what form does this azote escape? In the form of ammonia. Here, indeed, one of those observations presents itself which never fail to fill us with admiration for the simplicity of the means which nature puts in operation.

If in the general order of things we return to the air the azote which certain vegetables may sometimes directly make use of, it ought to happen that we should also be bound to return ammonia, a product so necessary to the existence and development of most vegetables.

Such is the principal result of the urinary secretion. It is an emission of ammonia, which returns to the soil or to the air.

But is there any need to remark here, that the urinary organs would be changed in their functions and in their vitality by the contact of ammonia? the contact of the carbonate of ammonia would even effect this; and so nature causes us to excrete urea.

Urea is carbonate of ammonia, that is to say, carbonic acid like that which we expire, and ammonia such as plants require. But this carbonate of ammonia has lost of hydrogen and oxygen so much as is wanting to constitute two molecules of water.

Deprived of this water the carbonate of ammonia becomes urea; then it is neutral, not acting upon the animal membranes; then it may pass through the kidneys, the ureters, and the bladder, without inflaming them: but, having reached the air, it undergoes a true fermentation, which restores to it these two molecules of water, and which makes of this same urea true carbonate of ammonia; volatile, capable of exhaling in the air; soluble, so that it may be taken up again by rain; and consequently destined thus to travel from the earth to the air, and from the air to the earth, until, pumped up by the roots of a plant and elaborated by it, it is converted anew into an organic matter.

Let us add another feature to this picture. In the urine, along with urea, nature has placed some traces of albuminous or mucous animal matter, traces of which are barely sensible to analysis. This, however, when it has reached the air, is there modified, and becomes one of those ferments of which we find so many in organic nature; it is this which determines the conversion of urea into carbonate of ammonia.

These ferments, which have so powerfully attracted our attention, and which preside over the most remarkable metamorphoses of organic chemistry, I reserve for the next year, when I shall give you a still more particular and full account of them.

Thus we discharge urea accompanied by this ferment, by this artifice, which, acting at a given moment, turns this urea into carbonate of ammonia.

If we restore to the general phenomenon of animal combustion that carbonic acid of the carbonate of ammonia which of right belongs to it, there remains ammonia as the characteristic product of urine.

Thus, by the lungs and the skin, carbonic acid, water, azote.

By the urine, ammonia.

Such are the constant and necessary products which exhale from the animal.

These are precisely those which vegetation demands and makes use of, just as the vegetable in its turn gives back to the air the oxygen which the animal has consumed.

Whence come this carbon, this hydrogen burnt by the animal, this azote which it has exhaled in a free state or converted into ammonia? They evidently come from the aliments.

By studying digestion in this point of view, we have been led to consider it in a manner much more simple than is customary, and which may be summed up in a few words.

In fact, as soon as it was proved to us that the animal creates no organic matter; that it merely assimilates or expends it by burning it (en la brûlant,) there was no occasion to seek in digestion all those mysteries which we were quite sure of not finding there.

Thus, digestion is indeed but a simple function of absorption. The soluble matters pass into the blood, for the most part unchanged; the insoluble matters reach the chyle, sufficiently divided to be taken up by the orifices of the chyliferous vessels.

Besides, the evident object of digestion is to restore to the blood a matter proper for supplying our respiration with the ten or fifteen grains of coal, or the equivalent of hydrogen, which each of us burns every hour; and to restore to it the grain of azote which is also hourly exhaled, as well by the lungs or the skin as by the urine.

Thus the amylaceous matters are changed into gum and sugar; the saccharine matters are absorbed.

The fatty matters are divided, and converted into an emulsion, and thus pass into the vessels, in order to forms depôts which the blood takes back and burns as it needs.

The neutral azotated substances, fibrin, albumen, and caseum, which are at first dissolved, and then precipitated, pass into the chyle greatly divided, or dissolved anew.

The animal thus receives and assimilates, almost unaltered, the azotated neutral substances which it finds ready formed in the animals or plants upon which it feeds; it receives fatty matters, which come from the same sources; it receives amylaceous or saccharine matters, which are in the same predicament.

These three great orders of matters, whose origin always ascends to the plant, become divided into products capable of being assimilated, fibrin, albumen, caseum, fatty bodies which serve to renew or recruit the organs with the combustible products, sugar and fatty bodies which respiration consumes.

The animal therefore assimilates or destroys organic matters ready formed; it does not create them.

Digestion introduces into the blood organic matters ready formed; assimilation employs those which are azotated; respiration burns the others.

If animals do not possess any peculiar power for producing organic matters, have they at least that special and singular power which has been attributed to them, of producing heat without expenditure of matter?

You have seen, while discussing the experiments of MM. Dulong and Despretz, you have positively seen the contrary results from them. These skilful physicists supposed that an animal placed in a cold water calorimeter comes out of it with the same temperature that it had on entering it; a thing absolutely impossible, as is now well known. It is this cooling of the animal, of which they took no account, that expresses in their *tableaux* the excess of heat, attributed by them and by all physiologists, to a calorific power peculiar to the animal, and independent of respiration.

It is evident to me that all animal heat arises from respiration; that it is measured by the carbon and hydrogen burnt. In a word it is evident to me that the poetical comparison of a railroad locomotive to an animal, is founded on a more serious basis than has, perhaps, been supposed. In each, there are combustion, heat, motion; three phenomena connected and proportional.

You see that, thus considering it, the animal machine becomes much easier to understand; it is the intermediary between the vegetable kingdom and the air; it borrows all its aliments from the one, in order to give all its excretions to the other.

Shall I remind you how we viewed respiration, a phenomenon more complex than Laplace and Lavoisier had thought, or even Lagrange had supposed, but which, precisely as it becomes complicated, tends more and more to enter into the general laws of inanimate nature?

You have seen that the venous blood dissolves oxygen and disengages carbonic acid; that it becomes arterial without producing a trace of heat. It is not, then, in becoming arterial, that the blood produces heat.

But under the influence of the oxygen absorbed, the soluble matters of the blood change into lactic acid, as MM. Mitscherlich, Boutron-Charlard, and Fremy observed; the lactic acid is itself converted into lactate of soda; this latter, by a real combustion, into carbonate of soda, which a fresh portion of lactic acid decomposes in its turn. This slow and continued succession of phenomena which constitutes a real combustion, but decomposed at several times, in which we see one of the slow combustions to which M. Chevreul drew attention long ago, this is the true phenomena of respiration. The blood then becomes oxygenised in the lungs; it really breathes in the capillaries of all the other organs, there where the combustion of carbon and the production of heat principally take place.

A last reflection. To ascend to the summit of Mont Blanc, a man takes two days of twelve hours. During this time he burns at an average 300 grammes of carbon, or the equivalent of hydrogen. If a steam engine had been employed to take him there, it would have burnt from 1,000 to 1,200 to accomplish the same work.

Thus, viewed as a machine, borrowing all its power from the coal that it burns, man is an engine three or four times more perfect than the most perfect steam engine. Our engineers have, therefore, still much to do; and yet these numbers are quite such as to prove that there is a community of principles between the living engine and the other; for, if we allow for all the inevitable losses in steam engines which are so carefully avoided in the human machine, the identity of the principle of their respective powers appears manifest and clear.

But we have followed far enough considerations as to which your own reflections are already in advance of me, and where your recollections leave me nothing more to do.

To sum up, then, we see that of the primitive atmosphere of the earth, three great parts have been formed:

One which constitutes the actual atmospheric air; the second, which is represented by vegetables; the third, by animals.

Between these three masses, continual exchanges take place; matter descends from the air into plants, enters by this route into animals, and returns to the air according as these make use of it.

Green vegetables constitute the great laboratory of organic chemistry. It is they which, with carbon, hydrogen, azote, water and oxide of ammonium, slowly build up all the most complex organic matters.

They receive from the solar rays, under the form of heat or of chemical rays, the powers necessary for this work.

Animals assimilate, or absorb, the organic matters formed by plants. They change them by little and little; they destroy them. In their organs, new organic substances may come into existence, but they are always substances more simple, more akin to the elementary state, than those which they have received. By degrees these decompose the organic matters slowly created by plants; they bring them back, little by little, towards the state of carbonic acid, water, azote, and ammonia, a state which allows them to be returned to the air.

In burning or destroying these organic matters, animals always produce heat, which, radiating from their bodies in space, goes to supply the place of that which vegetables had absorbed.

Thus all that air gives to plants, plants give up to animals, and animals restore to the air; an eternal circle, in which life keeps in motion and manifests itself, but in which matter merely changes place.

The brute matter of air, organized by slow degrees in plants, comes, then, to perform its part without change in animals, and serves as an instrument for thought; then, vanquised by this effort, and broken as it were, it returns brute matter to the great reservoir whence it came.

Allow me to add, in finishing this picture, which sums up opinions, which, to my mind, are but the necessary consequences and developments of the great path which Lavoisier marked out for modern chemistry; allow me, I say, to express myself as he did with regard to his fellow labourers and his friends.

If in my lessons, if in this summing up, I have chanced to adopt, without mentioning it, the experiments or the opinions of M. Boussingault, it is that the habit of communicating to each other our ideas, our observations, our manner of viewing things, has established between us a community of opinions, in which we ourselves, even afterwards, find it difficult to distinguish what belongs to each of us.

In resting these opinions and their consequences on his name and on his authority, in telling you that we work actively, sometimes together, and sometimes apart, in order to verify and to develope all these facts, all these results, by experiment, I do but evince my anxious desire to justify the interest which you have this year taken in my labours.

For this I beg to thank you. It has given me courage to undertake a long course of researches: if anything useful to the progress of humanity should result from them, let all the honour of it redound to the intelligent good-will with which you have constantly surrounded me, and for which I shall ever be profoundly grateful.

[From the American Journal of Science for October.*]

On the Evidence of a general Whirling Action in the Providence Tornado. By W. C. Redfield.

On the 30th of August, 1838, between the hours of 3 and 4 P. M., a violent whirlwind, or tornado, visited the town of Providence, in the State of Rhode Island. It was preceded by a shower of rain of short duration, after which the tornado appeared, appended to another cloud, and passed through the southern part of the town nearly from west to east.

Its earliest ravages reported, were in Johnston, at the farm of Mr. Randall, about seven miles west from Providence. From this point it passed on through Cranston and Providence, where, crossing the river into the State of Massachusetts, it passed through Seekonk, Rehoboth, Swansey, Somerset, and as far, at least, as Freetown, beyond Taunton river; a distance of twenty-five miles from the point first mentioned.

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* Communicated by the Author for the Journal of the Franklin Institute.

The width of its visible track, as indicated by the prostration of trees, fences, and other objects, varied from a mere trace in its narrowest, to two hundred yards or upwards in its widest portions. Having, a few days after the occurrence of the tornado, carefully examined the track for the distance of about seven miles, on each side of Providence river, I propose to offer some of the results of this examination, together with such remarks as may seem justly deducible from the effects observed.

So far, however, as the impressions made on an accidental eye-witness of the tornado may be important, we have a valuable account furnished us in the letter of Zachariah Allen, Esq., of Providence, which is given in Dr. Hare's notice of this tornado. [Silliman's Journal, vol. xxxviii, p. 74–77.] Mr. Allen had the advantage of viewing its progress from a point near its path. He calls it a "whirlwind," and describes its phenomena in a manner perfectly consistent with this appellation. "The circle formed by the tornado" on the river, he describes as "about three hundred feet in diameter," and mentions, that the "misty vapors" . . . "entering the whirling vortex, at times veiled from sight the centre of the circle, and the lower extremity of the overhanging cone of dark vapor:" and that "amid all the agitation of the water and the air about it, this cone continued unbroken," &c.

This "cone" of the tornado of which he so often speaks, it should be noted was an *inverted* one, the smaller end of which was sweeping on the earth's surface.[*] Thus he gives the instance, "when the point of the dark cone of cloud passed over the prostrate wreck of the building, the fragments seemed to be upheaved," &c. It will be seen here that the *prostration* of the building had preceded the arrival of the centre or "point" of the "cone;" showing that the whirlwind often acts on a large area, with great force, *externally* to the lower part of the *visible* cone, or the column of vapor at its axis. Moreover, the substances which by the centre of the tornado were "uplifted high in the air," were "left to fall from the OUTER EDGE of the black conical cloud."[†]

Mr. Allen says further, "The progress of the tornado was nearly in a straight line, following the direction of the wind, with a velocity of perhaps eight or ten miles per hour. Near as I was to the exterior edge of the circle of the tornado, I felt no extraordinary gust of wind; but noticed that the breeze continued to blow uninterruptedly from the same quarter from which it prevailed before the tornado occurred. I also particularly observed that there was no preceptible increase of temperature of the air adjacent to the edge of the whirlwind, which might have caused an ascending current by a rarefaction of a portion of the atmosphere."

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[*] We may properly conceive of this "cone," in tornadoes or water-spouts, as including not only the visible, clouded condensation here described, but also the invisible portion of the whirlwind which surrounds the narrow and depending portion of the visible cone, below the general line of condensation. Thus the *entire* body of the whirlwind is generally a truncated cone; its smaller and most active end sweeping along the surface of the earth or sea.

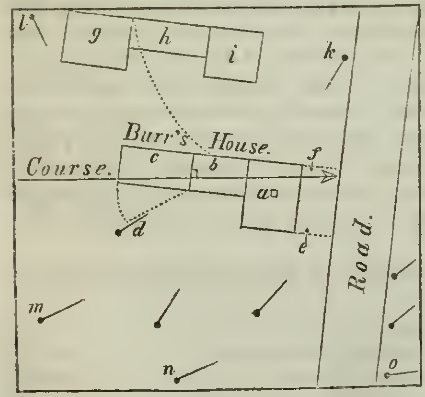
[†] Mr. Allen states that the form of the cloud and of the cone of vapor depending from it so nearly resembled the engraved pictures of "water-spouts" above the ocean, that he should have come speedily to the conclusion that one of these "water-spouts" was approaching, had he not been aware that "this phenomenon occupied a space in the heavens directly above a dry plain of land." Perhaps it might be inferred that Mr. A. had partaken of the too common notion, that the misnamed *water-spout* is, or should be, literally a *spout of water*. This phenomenon, so much talked of among mariners, proves to be nothing more nor less than the visible, inverted "tapering cone of vapor" or condensation, noticed by him as "extending from the cloud to the surface of the earth," *at the axis or ascending portion of the whirl;* if we may at all rely on the results of extensive examinations and comparisons of the accounts of "water-spouts" and their effects. The same appearance was observed in the New Brunswick

Soliciting a careful attention to the observations of Mr. Allen, who is well known for his intelligence and his habits of correct observation, I proceed to give some account of my own examinations of the traces of this tornado.

From a point on the rocky "ledge" north of the turnpike road and nearly three miles westerly from Providence, to the house of John Burr on the Cranston road, a distance of about one and a quarter miles, I found the course of the tornado to have been S. 86° E. by compass, over a plain country. The magnetic variation being here about 8° westerly, makes the true course E. 3° N. From this point to Providence river, a distance of about two miles, the course was five degrees more northerly.

I agree with Dr. Hare that the general effects observed on this track were "quite similar" to those of the New Brunswick tornado; and will give such of my sketches, formerly prepared, as will best illustrate this similarity and the general effects here mentioned.

Fig. 1. *Providence Tornado.**



The annexed is a sketch [Fig. I,] of some of the effects on the farm of Mr. Burr: His house is about one mile and a half from the Providence bridge.

In this figure, *a* represents a wooden dwelling-house of two stories, with chimney at its centre: *b* a dwelling added to *a* and extending to the rear: *c* a lighter building about 16 feet by 30, attached to the rear of *b*: *g* was a large wooden barn: *h* a long building or shed extending from the barn to the carriage-house *i*. The width of the visible track

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tornado by experienced seamen navigating the Raritan river, who at once pronounced it to be a water-spout, and took their measures accordingly. It is probable, however, that most of the "water-spouts" noticed at sea, are inferior in size and energy to these destructive tornadoes.

A "water-spout" was seen by Messrs. Tyerman and Bennet near Borabora in the Pacific, which extended nearly horizontally from one cloud to another directly over their heads; and no harm done! The most credulous will hardly conceive this to have been *a column of water*, or even approximately such; besides, no sea-water has ever been known to fall from the clouds. Similar "spouts" have been seen by others; and I once beheld a magnificent example of this kind, in one of the interior towns of Connecticut; which probably indicated an axis of rotation nearly horizontal.

* On these plans the large dot at the end of the several short lines, shows the original position of the root of the tree; the pointed end of the line shows the direction of its top.

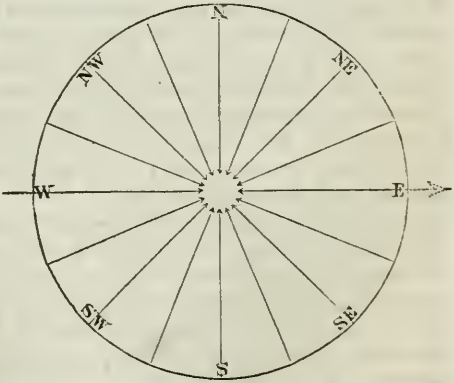
was here about five hundred feet, and the course of the centre or axis of the tornado appeared to have passed somewhat diagonally over the first three named buildings.

The house *a* withstood the shock, receiving some damage; the chimney top of *b* was thrown on the roof of *a*, perforating the same, while *b* was unroofed and greatly injured, and a long timber or *sill* from the shed *h* broke endwise into the upper part of the house *b* from a northwesterly direction. The building *c* was turned more than twenty feet to the *left about*, as regards the axis of the whirlwind, against the top of the prostrated pear tree *d*, and was there overturned upon it. There were twenty-one persons in *a* and *b*, including a school of children, none of whom were seriously injured.

The barn *g* and the shed *h* were destroyed, and the materials swept off toward the first named buildings. A corn-house, standing on the same side with the barn, is stated in the Providence papers to have blown over to the *west*, but I can find no notes of my own respecting the direction of its fall.

The effects here exhibited appear to me to be due to a progressive whirlwind, revolving to the left; for we may notice, as in the New Brunswick tornado, a more onward direction in the trees prostrated on the *right* of the axis, *d*, *m*, *n*, *o*, &c., than on the left side; while the outermost prostrations on the right, *n*, *o*, point still more nearly than the average on this side, to the course of the tornado: And on the left side of the track we have the tree *k* in a direction inclined several degrees *backward* from the course of the storm. The value of these indications of whirling action I have endeavoured to point out in my remarks on the New Brunswick case. [This Journal, vol. ii, 3rd series, 1841, p. 41–48.]

Fig. II.



At the front of the house *a*, however, were two slatted door-yard fences, extending from the house to the road. The fence *e* was overthrown northward towards *f*, and the fence *f* in the contrary direction towards *e*: both directions being *transverse* to the line of the axis, which passes between them. Such cases have been adduced as supporting a directly inward course of the wind in the body of the tornado; or, as indicating two bodies of opposing wind meeting on a central line; but I draw a different conclusion.

Let Fig. II represent, horizontally, the directions of such centre blowing winds in the body of the tornado, and let it be supposed as passing over the area of Fig I, without revolving, so as the course of the centre will coincide with the arrow which indicates the course of the axis on that figure. It may thus be seen that on this hypothesis the wind must strike the fences *e, f,* either parallel to their length, or but little oblique; a direction of wind which seldom or never prostrates fences, even in the path of a tornado. Besides, *near the centre* of such an inward blowing tornado, where only it could act on these fences with *lateral* force, such winds must necessarily become neutralized both by blowing against each other and by turning upward to escape, thus having little effect at this point, within four feet of the ground. I say nothing here of the possibility of any winds blowing *with violence* in such central and opposing directions; which I could never conceive: for the entire spaces between the centripetal lines of arrows must be conceived as being filled by the affluent winds; the lines only indicating their directions.

But on the other hand, let us suppose a strong whirlwind passing in the same direction: the front half of which, both on and near the line pursued by its axis, must necessarily sweep laterally across this line, first *northwardly* towards *f,* if it be revolving to the left; and the last half of the whirl on its arrival will sweep *southwardly* towards *e*; which sufficiently accounts for the effects observed. That only the fence *e* was thus prostrated by the first wind of the tornado may be explained by the protection afforded to *f* by the house, against the *advancing* whirl, and perhaps here, also, by the spirally *upward* tendency towards the centre, in the wind which thus came round the southeast corner of the house, prostrating *e* in its course. But on the passing of the axis of the whirl, the wind would recur with increased force from the opposite direction, upon the fence *f,* prostrating it towards *e*; while the latter, being already down, and in turn partially protected by the house, would remain as it first fell.

In passing over the track of the tornado between Burr's house and Providence river, several instances and groups of prostration were observed. But owing to the open character of the grounds throughout most of the track, the memorials afforded by the trees were less frequent than have been seen in other cases.

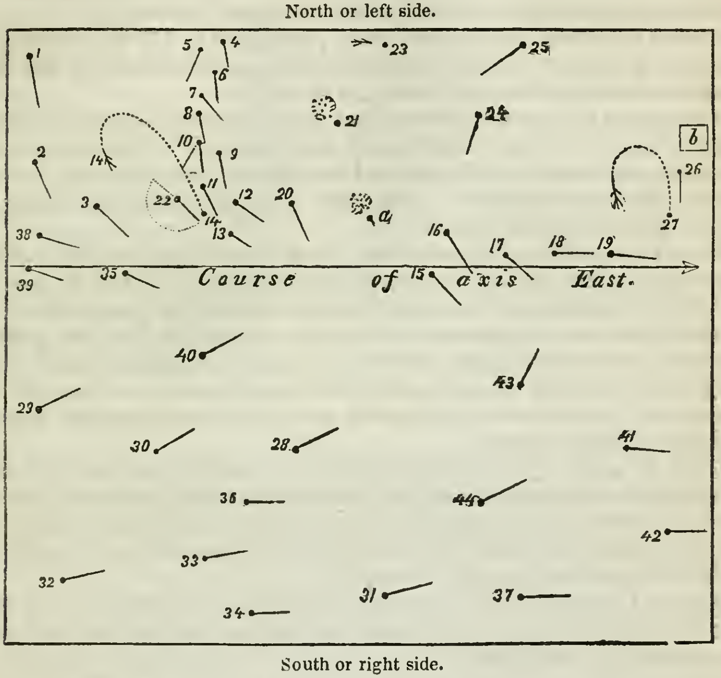
Near the Pawtuxet turnpike, the tornado encountered a new house belonging to Mr. Gardner. This house was in the southern portion of the track *on the right of the axis,* and was removed and *turned* several feet *towards the left.*

It is proper to mention here that the *order of changes* in the wind's *direction,* viewing the tornado either as a whirlwind, or, as claimed by Mr. Espy and seen in Fig. II, would at any *fixed point* on this the right side of the track, be successively *towards the right,* as relates to the centre of the tornado. But this building having received its motion by yielding to the wind, shows the true course of the latter as whirling to the left.

Passing by the prostration of the range of buildings near the river, described by Mr. Allen, I proceed to notice the effects which appeared on crossing to the Massachusetts side.

From the bank of the river to the house of Abraham Tifts on the Lyon farm, three-fourths of a mile, the grounds were open and unbroken, being mostly under cultivation and with few trees exposed to the tornado, excepting an orchard of scattered apple trees westward of Tifts' house. The traces of the wind in and adjacent to this orchard were very distinct in their character, and I subjoin here the sketch on which they are represented.

Fig. III. *Providence Tornado.*



Explanations of Fig. III.—The cases of prostration 4 to 14, were from a line of small locust trees on the west border of an old apple orchard, and are severally shifted a little out of line for the sake of a distinct exhibition of their directions.

From thence to near Tifts' house at *b*, the ground is but slightly foreshortened, and the relative positions of each tree, on the left of the centre, is approximately shown. The figure was drawn from my field notes on account of the distinct phenomena which were exhibited on this part of the track, and which, in cases *a*, 14, 22, 21, 23, and 27, show conclusively the first action of the whirl *across the path of the axis*, and sweeping towards the northern border of the track. On the opposite or right side of the axis, southward of 15, there were no trees exposed, and the effects of the tornado were here visible only on the crops and fences. Therefore the cases shown on the figure south of the axis, and also westward of 22 on the left hand side, were brought in from the more western parts of the track between the orchard and the river, and include all the prostrations from the latter to Tifts' house;

and their relative distances from the axis or centre of the track are but approximated.

Case 14, represents a small locust tree broken off at an old wound near the root and carried *outward and backward* into the adjoining fallow field, having struck into the ground several times in its course, leaving distinct traces. It was finally left at a point N. 57° W. from its stump, at the distance of forty yards, with its top turned southwardly, in conformity with its two last traces in the soft ground.

Case 10, a small locust tree was prostrated S. 25° W., leaving its mark in the fallow ground. It was subsequently shifted, by the progressive change in the whirlwind, to S. 11° E.

Case *a*, an old apple tree with but a single branch projecting southwardly from its trunk: This branch was taken off by the onset of the tornado, and struck into the ground northwest from the trunk, depositing its apples at this spot. The limb itself was missing.—Case 21, apples deposited as in case *a*.

Case 22, a small wild cherry tree, was found lying on and against the stump of 14, having first been thrown *from the latter* by the onset of the wind and subsequently swung round by the south to its present position, as appeared by the impressions made in the ground. Its final position was such, as if occurring at the outset would have prevented 14 from being carried off northwesterly.—Case 23, the branch of an apple tree was thrown west.—At *b* is shown the relative position of Tifts' house.

Case 27, shows the original position of a large pear tree, the stem of which was broken off and first thrown northward, where it ploughed up the soft ground of the garden by its force, and continued its circuit to a point northwest of its original position, where it remained with its top turned toward the south.

For the purposes of a general comparison, the observed or first known directions of the prostrations on the two sides of the track may be summed up as follows.

Left or North side of the Track.			*Right or South side of the Track.*		
Case.	Direction of first prostration.	Inclination inward and backward from course of tornado.	Case.	Direction of first prostration.	Inclination inward and backward from course of tornado.
38	S. 74° E.	16 degr's.	29	N. 65° E.	25 degr's.
39	S. 70 E.	20	32	N. 77 E.	13
35	S. 67 E.	23	30	N. 60 E.	30
1	S. 10 E.	80	33	N. 80 E.	10
2	S. 23 E.	67	34	N. 88 E.	2
3	S. 45 E.	45	36	East,	0
4	S. 12 E.	78	40	N. 65 E.	25
5	S. 35 W. (backw'd)	125	28	N. 63 E.	27
6	S. 5 E.	85	31	N. 75 E.	15
7	S. 40 E.	50	44	N. 63 E.	27
8	S. 11 E.	79	37	N. 87 E.	13
9	S. 10 E.	80	43	N. 30 E.	60
10	fell S. 25W. turned to S. 11 E.	115	41	S. 85 E.	5
			42	East,	0

Case.	Direction of first prostration.	Inclination inward and backward from course of tornado.
11	S. 26° E.	64 degr's.
12	S. 55 E.	35
13	S. 55 E.	35
14	first thrown N. 23 W. (backward)	247
15	S. 45 E.	45
16	S. 30 E.	60
17	S. 55 E.	35
18	East,	0
19	S. 85 E.	5
20	S. 27 E.	63
21	N. 55 W. (backw'd)	215
22	first fell N. W. turned to S. 37 E.	225
a	N. 45 W. (backw'd)	225
23	Branch of apple tree thown west	183
24	S. 20 W. (backw'd)	110
25	S. 55 W. (backw'd)	145
26	South,	90
27	first thrown N. 10 W.	260

Mean direction of prostration on the right side of the track N. 73° E.: average inclination inward from course of tornado, *seventeen degrees.*

Mean direction of first prostrations on the *left side* of track, S. 4° W.: average inclination inward and backward from course of tornado, *ninety-four degrees.*

Relative inclinations of the two sides to the line of axis, more than *five* to *one.*

It is proper to mention, that the average inward inclination of *all* the prostrations on the *right* side of the track for a distance of four miles east of the river was thirty degrees.* This, however, does not affect the conclusions in favor of rotation to the left.

These average results, on the two sides, together with the several particular observations already adduced, appear to me to afford decisive evidence of whirlwind rotation in this tornado, in the direction from right to left or which is contrary to the hands of a watch. In reference to this evidence and that exhibited in my paper on the New Brunswick tornado, I add from my prepared sketches the following figure, as an approximate illustration of the whirling action in these tornadoes, so far as this may be shown *horizontally* and by a stationary figure.

Let the involuted lines or arrows on figure IV be supposed to represent the motion of the wind at or near the bottom of a vertically cylindrical portion of the centre of a tornado, comprising a length of radius equal to the greatest width of the prostrating power on the right of the axis of its path. Now if the tornado be considered as whirling in the manner here represented, but *without any change of location,* its action may be supposed as concentrically equal on all sides; the motion, however, becoming quickened towards the centre in the *inverse ratio* of the successive concentric areas: that is, each particle of air as it revolves about the axis, *continuing to describe nearly equal areas in equal times,* in its progress towards the centre, where it rises spirally in the direction of discharge; this direction being vertically at the centre, the point or area of least atmospheric resistance or pressure. Thus, the course of a single particle, horizontally, may be *a b*

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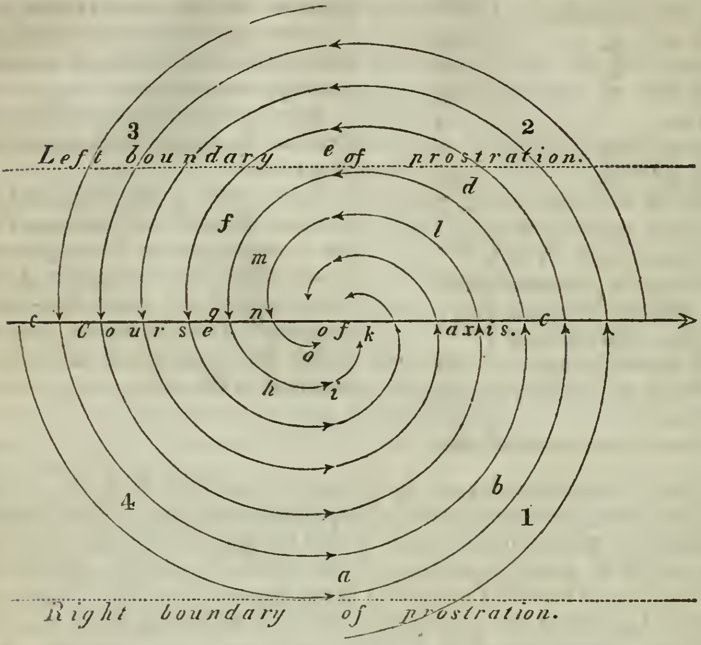
* This larger average gives a relative degree of inclination on the two sides of *three* to *one.* Nearly the same difference is found in two outside bands of prostration, of equal widths, (Tables I and V,) shown in my survey of the New Brunswick Tornado. See this Journal, vol. ii, 3rd series, 1841, p. 44.

c d e f g h i k;—and so on or between each of the four involuted lines which constitute the figure.

For further reference, we may divide this figure by the cross lines of arrow heads, into the four quadrants 1, 2, 3, 4.

Fig. IV.



We will now consider this whirl as having *a constant progressive motion* on the line of the long arrow *c c*, at a rate equal to one-fourth or fifth of its average rotative velocity. It will then follow, that as the force of the whirl on the trees and other objects encountered by it, is *as the square of the wind's velocity* at the point of impingement, the relative effects on the two sides of the line of the axis, which before were equal, will now be greatly altered.

For, if at a given distance *on the right* of the advancing axis, the former velocity was 80, it will now, as relates to the earth's surface, have become 100; and at the same distance on the *left* side the velocity of the wind will be reduced to 60, as relates to the earth's surface. Thus the squares of these effective velocities will give a power relatively equal to 100 at the former point and only 36 at the latter; both being equally distant from the axis. Hence, although the *rotative* velocity of the whirl decreases rapidly as we recede from its axis, yet its *prostrating* power will, by its progressive motion, become greatly extended on the *right* side of the advancing axis, and proportionally contracted on the left side. Thus the respective boundaries of the prostrating power on the two sides of the tornado, when thus in motion, may be those indicated on the figure; which nearly correspond to the effects which have been observed in several cases.

It may be seen further, that *nearly all the prostrations* near the line of the axis and elsewhere, must by the advancing motion of the tornado, receive a direction *more onward* than is represented by the arrows or lines in the figure, which can represent only a stationary rotation.

In further considering these effects, in different portions of the whirl, as it encounters objects in its advance, we shall find the maximum effects to be mainly on the line *a, i, o,* at the rear of the *first quadrant.* Hence, if a tree on this side the axis should fail to be prostrated till after the first quadrant had passed over, it would not be likely to fall in the fourth quadrant, on the further advance of the tornado, unless very near to its axis. Moreover, if one tree should fall when under the more advanced portion of the first quadrant, another if prostrated later in the same quadrant, must necessarily fall in a *more onward* direction than the first, and if sufficiently near will lie across the latter.

It may likewise be seen, that the wind of the whirl in passing into the *second quadrant,* on the left side of the track, is sweeping *backward,* and with its effective power thus greatly reduced, as regards fixed objects on the earth's surface. Thus the limits of prostration are not only narrowed, but the effective power is here greatly reduced, and gives *fewer prostrations* than under either the first or third quadrants. The *minimum* of effect occurs on the arrival of the line *e k*, at the rear of the second quadrant.

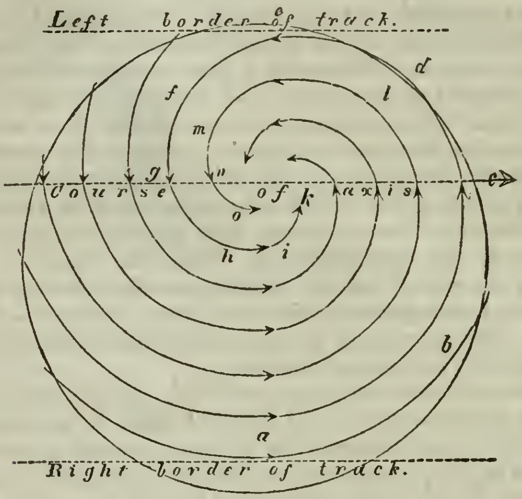
But on the arrival of the *third quadrant,* the prostrating power on the left side becomes more and more efficient by the ceasing of the backward and the accession of the progressive movement; and at or near the line of *f m,* it again takes effect, with rapid increase. The destructive force is also much augmented here by the greater velocity in the heart of the whirl, near its axis, and the impetus must rapidly incease in energy to its maximum effect, as at *m n o,* taking off any tree which may here remain, and carrying aloft, or sweeping onward, the objects previously prostrated on the line *c x k.*

If a tree on the *left* side of the track falls on one previously thrown down by the tornado, the last fallen will also have the more onward direction, as on the other side: unless both have fallen in the second quadrant, where few prostrations occur. The *fourth quadrant,* for causes noticed in considering the *first,* can have little prostrating effect; except perhaps on the small area near its axis.

If we now conceive of our figure as applied only to the limits of prostration or destruction which constitute the *visible path* of the tornado, it becomes apparently and relatively unequal, in its right and left hand quadrants, the axis appearing greatly eccentric, and in the same degree, at least, as the *left* band or belt of prostrations is found narrower than that on the right of the axis. This apparent, but illusive form of the whirl, may be illustrated by Fig. V, which is drawn on the same lines with the preceding figure.

It will readily be seen that this eccentricity of the axis, on the visible track, will be in proportion to *the progressive velocity of the tornado;* other things being equal. Thus, if Mr. Allen be nearly right in his estimate of the rate of progress in the Providence tornado, the eccentricity shown in its path would be generally less than is shown in figures IV and V. On the other hand, if the progressive velocity should be as great as Professor Loomis informs me he ascribes to the tornado of February last, in Ohio, viz. about forty miles an hour, the eccentricity would in such a case be greatly increased, showing the axis as far outward, perhaps, as would be in line with *m*, or *f l*, in these two figures.

Fig. V.



From this examination it appears to result, that an observer who follows the track of a tornado after its departure, will find on one side of the apparent axis of its path, *if it be a whirlwind,* a continued series of prostrations pointing almost invariably onward and inward, with various degrees of inclination to the course of the path. While on the other side of the axis, a narrower band or belt of prostrations will be found, which are also inclined mainly inward and onward, but showing greater inclinations from the line of progress, together with frequent cases which incline more or less backward and sometimes even outward from the course of the tornado.

It may also appear, that a want of proper attention to the necessary conditions of the prostrating power in a progressive whirlwind, can alone induce us to ascribe such effects to supposed antagonistic winds, blowing simultaneously in opposing directions.

Leaving, for a moment, the more tangible features of this inquiry, we may now take some notice of the more outward portions of the "cone" or whirlwind, which are supposed not to be comprised in Fig. IV. Assuming here the involuted and inward motion, with its upward discharge at the centre, it follows that the impulsive accession of air which is necessary for maintaining a violent whirlwind action, must come in horizontally, and in the same gradually involuted courses;

or, must descend in like manner from a higher region, in and around the outward parts of the whirling cone. I have long since been led to believe that this impulsive accession comes from *both* these sources, but *chiefly from the latter;* and that this motion of accession and support is spirally *downward* in the outward portions of the whirl. The latter being, in its higher portions, often greatly expanded, as noticed by Mr. Allen.

The evidence on which this opinion rests, can be but partially alluded to here; but I will suggest the following considerations:—1. The ascertained existence of a stratum of unusually cold air in the higher region of clouds, on some particular days remarkable for the occurrence of numerous thunder gusts and tornadoes.* 2. The observed descent of a portion of the clouds in front of the nucleus or body of a heavy squall, or tornado, which may sometimes be traced by the eye as low as the existing limit of condensation will afford opportunity for observation. 3. The fact noticed by Mr. Allen and others, that adjacent "to the exterior edge of the circle of the tornado" or whirlwind, the previous breeze often continues "to blow uninterruptedly from the same quarter" as before.† 4. The last fact, when taken also in connexion with certain peculiar and striking effects in the outward portions or edge of the tornado, a knowledge of which I have gathered from various sources. 5. The coldness of the air which has been noticed at the edge of a whirlwind. 6. The instant penetration of the lower end of the whirlwind into thick forests, and into hollows and ravines, which has been frequently noticed. 7. The direct memorials of downward action in the outward portions of the whirl, which I have myself met with, on the tracks of different tornadoes.

In most of the foregoing remarks it has been my design to view the tornado as it moves onward, in full action. Of the origin or incipient causes of the whirl, it is not necessary here to inquire; although some clue to these is perhaps afforded us in the considerations above noticed.

Recurring once more to the track of the Providence tornado, I have to state that eastward of Tifts' house the course of the track soon became S. 65° E. magnetic, for more than two miles. It then took the course of S. 75° E., and further onward the tornado passed directly over the house of Solomon Peck, about four miles from Providence. This house was partly unroofed; chimney thrown down; windows broken *inward*, as in many other cases; and much other damage was also done to Mr. Peck's property. In passing onward towards Taunton river the tornado appears to have preserved an inclination to the south of east: the track, though slightly sinuous, appearing, like that of the New Brunswick tornado, to form part of a great curve, with its convex side to the northward.

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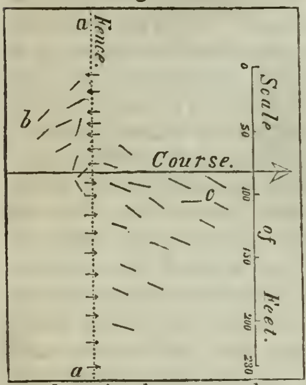
* This change of upper temperature I think can be clearly made out on the day of the New Brunwick tornado, which was but one of many tornadoes and thunder gusts which appeared in this part of the United States on the same day; and on the preceding day in Illinois and other western states.

In the New Haven Gazette are accounts of *five* severe tornadoes which occurred in the states of New Jersey, Connecticut, Massachusetts and Rhode Island, on the afternoon of August 15, 1787. I can also refer to many more recent cases of this kind.

† The observation here quoted is one of many which show the error of the very hasty generalization which alleges a circuit or annulus of calm air to have been observed *on all sides* of tornadoes and hurricanes.

On the track from the Lyon farm to Peck's house there were many interesting memorials which might confirm the deductions already made. On some portions of the track, also, the tornado appeared to have risen almost entirely from the surface, its reverse apex leaving but a narrow trace, and on some fields, even no trace at all. But in these cases, as on the tracks of other tornadoes, the compass bearing did not fail to lead the explorer to new ravages, where, at times, the energy of the tornado appeared to be greater than before.*

Fig. VI.



Before we take leave of the traces of this tornado I would adduce another of my prepared sketches, which shows the rotative effects in a manner which I think should satisfy the most strenuous opposer of whirlwind action. In this sketch, Fig. VI, we have represented a portion of the track which crossed at right angles a line of weak post-and-rail fence, *a, a.* On the *right* of the axis, this fence was prostrated *eastwardly* or in the direction of the course of the tornado, as shown by the short arrows which may represent the posts of the fence; the rails also having been scattered onward and inward, towards *c*, in the general manner represented in the figure. On the *left* side, however, every post was prostrated *westwardly*, and the rails were likewise blown slightly backward toward *b*, in the same general direction. The scale of feet, which measures across the track, was obtained by estimating twelve feet to each length of the rails. The locality of this sketch was, perhaps, a mile eastward of the Lyon farm.

The application of the foregoing views of rotation to this case, it can hardly be necessary to point out.

I have noticed many effects of similar kind on fences; but that the *backward* prostration on the left side of the track should have taken full effect in this case, and mainly, perhaps, under the second quadrant, I ascribe to the age and general weakness of the fence.

Additional memorials might here be adduced in evidence, and of similar character to the foregoing; but having already occupied more space than I intended, I must now leave the question of a general whirlwind rotation in this and other tornadoes to the candid consideration of impartial inquirers.

New York, July 12, 1842.

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* This is not uncommon in tornadoes, and is especially noticed in the account of two "Trombes" which are given in Pouillet, Elemens de Physique et de Météorologie, § 655.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1841.

With Remarks and Exemplifications by the Editor.

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1. For an improvement in the Process of *Distilling;* Samuel Oliver, Northampton county, Pennsylvania, August 4.

This improvement, the patentee says, "consists in the introduction of wood ashes, lye, or potash, or either of them, into combination with the rye, corn, or other grain, after it has been mashed, and before the process of fermentation commences, and mixing it with the same in the proper proportions."

Claim.—"What I claim as my invention, discovery and improvement, and desire to secure by letters patent is, the application of wood ashes, lye, or potash, to the process of distillation of rye, corn, or other grain into whiskey, or alcohol, for the purpose of retarding the acetous fermentation and increasing the yield, using the specified quantities, or increasing or diminishing them as circumstances may require."

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2. For an improvement in the Handles or Tholes of *Scythe Snaths:* Selah W. Fox and Arestes Terry, Bernardstown, Franklin county, Massachusetts, August 4.

Claim.—"We claim as our invention, constructing the clamp ring of the tholes with a spring washer on the interior of the same, and combining the said clamp ring with a shank firmly fixed in the handles, and having a male screw at one end which engages with a corresponding female screw in the lower and conical shaped part of the clamp ring, the whole being constructed and operating together in the manner described and for the purpose of firmly confining the handle to the snath. We also claim forming the shank which is inserted in the wooden handle, with a shoulder, by means of which the shoulder operates to press the collar against the snath, and draws the clamp ring down upon the opposite side of the same, independent of the wooden part of the handle, the whole being for the purpose specified."

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3. For an improvement in the Process of *Hardening Steel;* Perry Davis, Fall River, Bristol county, Massachusetts, August 4.

The method of hardening steel as practiced by the patentee is as follows. "Instead of plunging the steel to be hardened into cold water, as is usual, it is plunged into a composition of borax, oil, and charcoal, to harden it, which mode of hardening renders the metal malleable with the same degree of hardness that was obtained by the old method; so that the metal, after being hardened in this way can be straightened or bent without any danger of being broken."

Claim.—"What I claim as my invention and which I desire to secure by letters patent is the mode of hardening steel so as to render it flexible by means of the composition of oil, charcoal, and borax, as set forth."

What influence the above described mixture can exert upon the part to be hardened, we are at a loss to perceive, and apprehend that the method frequently practiced of using oil alone, would have the same effect with the compound above indicated. We have been in the habit of hardening steel, and know of many devices which have been resorted to for the purpose of communicating toughness, but believe them all to be founded in error. The less rapid the cooling, the less will be the hardness, and, of course, the greater the toughness of the article operated upon.

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4. For an improvement in *Propelling Boats;* Meredith Mallary, Urbanna, Steuben county, New York, August 4.

There is to be a common water wheel, such as is used for driving mills, on each side of the vessel, or boat, immediately in the rear of the ordinary paddle wheel, and the shafts of the two sets of wheels are to be geared together; the water which is thrown up by the common paddle wheels is to fall into the buckets of the water wheels, and is there to lend its aid in the business of propelling.

Claim.—"Now what I claim as my invention is the applying the water lifted or thrown up by the paddle wheels of steam boats so as to produce an auxiliary propelling power, in the manner described, or in any way analogous thereto."

That these auxiliary wheels will exert some influence we have no doubt, but we are much mistaken if they do not prove to belong to the class of consumers only, and that of the worst kind, as they will not pay for what they devour.

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5. For an Ornamental *Covering for Stove Pipe Flues;* Perry Davis, Fall River, Bristol county, Massachusetts, August 4.

A plate is to be attached to a wall, where a stove pipe is to be inserted, with a hole in it to receive the end of such pipe, and a thin plate moving in suitable grooves, is to slide over and cover the hole, for the stove pipe, during summer when the stove is taken down.

Claim.—"I do not claim as my invention the construction of a plate with an aperture for stove pipes, having a slide to cover said aperture; but what I do claim as my invention and which I desire to secure by letters patent is constructing the perforated plate with a collar around the aperture to adapt it to the hole made by the stove pipe, in combination with the slide covering said aperture, as set forth."

In the whole catalogue of things patented we recollect but few so little worthy of the broad seal as the foregoing, and we are truly at a loss to perceive by what kind of logic it can be made to appear that a sliding cover to a stove pipe hole is a new and useful invention. There must have been some singular oversight, or obliquity of vision, when a patent was ordered to issue for such a common and valueless device.

6. For improvements in the *Condenser and Apparatus for Supplying Steam Boilers;* Joseph Echols, Columbus, Muscogee county, Georgia, August 11.

The apparatus, as described, for supplying boilers, consists of a receptacle, communicating with a cistern and with the boiler, by means of pipes governed by a four way cock which alternately forms a connection with the cistern, from which to receive the water, and then with the boiler to supply it with the water, thus received. The pipes forming these connections are narrow and high, and the one leading to the boiler has an inclination towards, and opens into, it, above the water line. Thus, when the communication between the boiler and receptacle is open, the steam from the former passes into the latter, and from this the water runs down the lower inclined surface of the tube into the former. The cock being then turned, cuts off this communication and opens it with the reservoir, which allows the water to run into the receptacle and condense the steam by which the water was expelled in the previous part of the operation. For low pressure engines, it is said that the top of the reservoir must be closed and a connection formed between it and the condenser.

The condenser is divided into two compartments, separated by a diaphragm pierced with small holes, and this forms a connection with a cistern of cold water by means of a fourway cock and receptacle such as are employed in the apparatus for supplying water, and operates in the same manner. The condenser is also connected with the cylinder of the engine, and is provided with an aperture and valve for the discharge of air and water. The water after passing from the cistern into the receptacle escapes into the upper division of the condenser, and percolating through the perforations in the diaphragm, condenses the steam. The air is forced from the condenser into the receptacle by the entering water, and in the same manner from the receptacle into the cistern.

Claim.—"What I claim and desire to secure by letters patent is, first, the manner in which I have combined and arranged the said cistern, receptacle, the said four-way cock, and the boiler, with said respective water passages, so as to effect the object of dispensing with force pumps (now in use for supplying boilers) and of giving a regular supply of water to the boiler, and of maintaining it at the same and desired height at all times, as above set forth. I do not claim the use of a four-way cock (except so far as using the plug of the same with only one passage through it) or of any of the respective parts of this apparatus taken individually, but I do claim them collectively in the particular combination described, not intending by this claim to limit myself to the exact form and manner of constructing the respective parts aforesaid, but to vary them as I may find expedient while they remain substantially the same, as herein before set forth. Secondly, I claim the manner in which I have combined and arranged the foregoing described apparatus for condensing steam and for discharging a portion of the air liberated therefrom without the employment of an air pump. That is to say, I claim the manner in which I have combined and arranged the cold water cistern, the steam receiver or condenser, the receptacle and the four-way cock, so as effect the condensation of steam and of discharging a portion, at least, and in some situations nearly all, the air from said receiver or condenser through the said receptacle and cock substantially as herein described."

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7. For an improvement in the manner of constructing *Furnaces for Warming Apartments,* and for Cooking; William A. Shepherd, Waterville, Kennebec county, Maine, August 11.

Claim.—"What I claim as my invention is the manner set forth of arranging an air heating and cooking apparatus, by surrounding the interior of an air heating stove, by ranges of tubes, within which the air is to be heated, and thence conveyed so as to pass around an oven, or other cooking instrument, and subsequently into any apartment where heated air is required." The particular arrangement of this apparatus could not readily be made known without a drawing, and this we do not think it worth while to give.

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8. For an improvement in *Cabooses or Cooking Stoves;* Loftis Wood, New York city, August 11.

In this stove there are two ovens, between and towards the upper part of which is the fire chamber, with an ash pit below. The grate bars below the fire are made hollow and open into each of the ovens, the side plate of each oven, towards the fire chamber, being pierced to receive each grate bar. The bars are pierced with holes on their under sides to receive air from the ash pit, which passes through them, and enters the ovens highly heated.

The bottom plates of the ovens are made to lift out, to give free admission to the flues beneath them. There is above this bottom plate a sliding, or false, bottom, which is usually made of open work, and has a rack on the underside into which a pinion works, for the purpose of sliding this false bottom in and out, together with the articles upon it which are to be baked.

Claim.—"What I claim therein as new, and desire to secure by letters patent, is the manner of combining the two ovens, the fire chamber between them, and the hollow grate bars, through each of which a current of heated air is admitted into each of the ovens, in the manner described. I also claim the false, or sliding, oven bottoms, having racks on their lower sides into which pinions mash, by which said bottoms are to be moved in and out by a combination and arrangement of parts, as set forth."

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9. For an improvement in the *Wind Mill;* Perry Davis, Fall River, Bristol county, Massachusetts, August 11.

This patent is taken for a modification of the ordinary vertical wind mill, with inclined sails, or vanes. The shaft of the wind wheel has its bearings in the upper part of a tower, which rests, and turns, on a circular railway, and on a hollow shaft attached to the main framing. A solid shaft passes through the hollow shaft of the tower and is made to revolve by a crown wheel on the shaft of the wind wheel; and from its lower end motion is communicated to any kind of machinery to be driven. The lower inner edge of the tower is provided with cogs into which the teeth of a pinion, on the end of a vertical shaft, take for the purpose of turning it. This last mentioned shaft is connected with a centrifugal regulator, or governor, the balls of which are operated on by a sliding clutch that clutches either of two bevel pinions on its shaft so that when the mill runs too fast the balls are thrown out so far as to clutch the upper wheel, and thus to turn the tower, and the wind wheel, from the wind; and when it runs too slowly, the balls fall, and clutch the lower wheel which turns the wind wheel to the wind.

Claim.—"What I claim as my invention, and which I desire to secure by letters patent is, the manner in which the movable tower is combined with the hollow stationary shaft, and main shaft of the machine, by making the hollow shaft stationary upon the frame as set forth, and causing the tower to revolve upon it, and combining the main shaft with the above arrangement by passing it through the hollow shaft in the manner described."

The second section of the claim is omitted, as it refers to, and would not be understood, without the drawings; it is, however, confined to the mode of regulating the position of the wheel in relation to the wind by means of the slide and clutch attached to the arms of the regulator, and clutching alternately the upper and lower wheels in combination with the cog rim on the tower.

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10. For an improvement in the *Cooking Stove;* Samuel L. Chase, Woodstock, Windsor county, Vermont, August 11.

The patent of which this is a reissue, was granted on the 25th of September, 1840, and is noticed in vol. ii of the third series of this Journal, page 345, to which the reader is referred for an explanation of its general characteristics. By comparing the following claim of the amended specification with the original, the reader will perceive the emendations which have been made in the patent.

Claim.—"Having thus fully described the nature of my improvement, and shown how the same is carried into operation, and having in so doing shown and described many parts and devices, of which I do not claim to be the inventor, I now proceed to state what I do claim, and desire to secure by letters patent, viz., first, the manner in which I have combined and arranged the flues, including the rarefier, as set forth, that is to say, the admitting the heated air from the fire chamber into the flue between the upper and the lower ovens; conducting it thence through the flue at one end of the flue under the lower oven, thence into the rarefying flue under the fire chamber, and thence into the exit pipe, all substantially as herein made known, and represented. Secondly, I claim, in combination, the arrangement of the respective parts of the hearth for broiling, and other cooking operations, which arrangement consists of the sunken hearth, furnished with the bars and openings for the admission of air, the swinging hearth, and the flue formed by the notch in said hearth, and the sloping projection at the lower edge of the furnace door, or on the swinging hearth. I also claim the swinging hearth in combination with the sunken hearth, whether the said swinging hearth be made in one or in two parts, such swinging hearth constituting, when closed, the top or cover of the sunk hearth, and being provided with boiler holes and otherwise constructed and arranged as set forth."

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11. For improvements in the *Cooking Stove* invented by Samuel L. Chase, Woodstock, Windsor county, Vermont, August 11.

This patent is for improvements in the stove noticed in the foregoing article, and, in the improved form, the sunk hearth, which is covered by the swinging hearth, is provided with grate bars near the bottom and the whole space is divided into two compartments by a partition, above and below the grate. A small draught hole is provided at each end. There are two ovens in this stove, one above the other, and back of the fire chamber, the flues passing over, under, and up the ends of each. There is one draught hole that enters from the fire chamber into the flue under the bottom of the lower oven, the draught dividing and passing up the two side flues, and over the top oven to the exit pipe, and three other draught holes that enter from the upper part of the fire chamber into the flue between the two ovens, the two outside ones opening partly into the vertical side flues, and being provided with dampers to regulate the draught.

Claim.—"What I claim is, first, the dividing the sunken hearth into two compartments, below the grate bars, in combination with a stove having a swinging hearth, and a draught space below the projections on said swinging hearth, in the manner and for the purpose described. I also claim the manner in which I have arranged and combined the flues, and the four spaces, or openings, leading into them from the fire chamber; the whole being constructed, governed, and operating as set forth."

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12. For a Locomotive *Battery for Harbor Defence;* Prosper Martin, Philadelphia, Pennsylvania, August 11.

The patentee proposes to make use of common steamboats in time of war for the defence of harbors, &c., by surrounding them with double or single floating batteries which are to form a hollow square. These batteries are to consist of two parts, which may be separated to receive the boat, or boats, and are then to be brought together and made fast.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the conversion of our common steamboats into locomotive batteries, for the protection of our harbors, cities, villages, &c., by securing the steamboats, in part or in whole, in an encasement, single or double, sufficient to protect them from injury, in manner substantially as herein described."

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13. For an improvement in *Stoves;* Thomas M. Jones, Boston, Massachusetts, now residing near Birmingham, England, August 11.

The improved stove is represented as being made cylindrical, and having a cylindrical case, or cap, surrounding and revolving on it, and resting on a ledge or flanch projecting all around the body of the stove at any height below the fire chamber. Instead of a door for supplying the fuel, a hole of sufficient size is cut in the body, or cylinder, of the stove, and through the outer casing, so that by revolving one on the other the opening in the body of the stove may be opened or closed at pleasure.

Claim.—"What I claim as my invention is a stove without doors having an internal vessel with a lateral opening for the admission of fuel connected with a movable or revolving external case that covers the whole, or any required portion, of the internal vessel—which external case has a lateral aperture corresponding to that of the inner vessel and is so adjustable that as it revolves more or less it may shut off either the whole, or none, or any part, of the lateral opening of the internal vessel."

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14. For a method of *Attaching Buttons to Garments;* Henry S. Poole, Boston, Massachusetts, August 11.

In the first place a metallic eyelet is made fast to the cloth in the usual way, and the button, which is made with a hollow cylindrical metallic shank, is rivetted on to the eyelet by means of a punch.

Claim.—"I claim as my improvement and ask a patent for the mode of fastening the button to the cloth by means of a metallic rivet attached to the shank of the button and fastened on a metallic, or other, eyelet, as set forth."

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15. For an improvement in the *Smut Machine* for Cleaning Grain; Jonas Nolt, West Hempfield township, Lancaster county, Pennsylvania, August 11.

The grain to be cleaned is to fall from the hopper into a shoe from which it is discharged on to a fall board, that is suspended by straps in an inclined position, its lowermost part being one of its corners; and the corner nearest the opening of the shoe where the grain is discharged on to it, being the next highest. The wind board of the fan, which is of the usual construction, directs the wind at an inclination downwards, so as to impinge upon the fall board a little within the lowest edge, the design of which is that as the heavy grains of wheat are rolling towards the lowest corner, the light smut balls may be blown off over the upper edge of the board. The shoe and the fall board receive a shaking motion in the usual manner of shaking the shoe of winnowing mills.

Claim.—"What I claim as my invention, and desire to secure by

letters patent, is the manner in which the fall board, the hopper, the shoe, and the board for directing the current of air upon the grain are combined together—that is to say, the arranging the hopper and shoe over the lower end of the wind board, and inclining the fall board on its inner side and one end so as to allow the grain to cross the current of air, the whole being constructed and operating substantially as set forth."

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16. For an improvement in the machine for *Cleaning Rice;* Daniel H. Southworth, Little Falls, Herkimer county, New York, Aug. 12.

A patent was granted to Mr. Southworth on the 23rd of August, 1838, for a rice cleaning machine, and is noticed in vol. xxiv of this journal, second series, page 93, to which patent the present improvement is added.

In the original machine, at the upper end of the revolving beaters there was a cast iron conical rubber, which, in connexion with the outer case, rubbed the grain before it passed down to be acted upon by the beaters, and in the present improved form this conical rubber is covered with card teeth.

Claim.—"What I claim as new and desire to secure by letters patent is the employment of a conical rubber of card teeth, or elastic wire points, in the place of my cast iron conical rubber, as described in my original patent; and this I claim whether said card teeth, or elastic wire points, be made to act upon the grain against the rough interior of the outer cone, or shell, or against the same part lined with wire teeth, or points, as set forth."

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17. For improvements in the *Hydrostatic Press for Pressing Cotton, &c.;* John Houpt, Forkland, Green county, Alabama, Aug. 21.

The follower of this press is below the bed, hence, in the operation of pressing, it is forced upwards; and to insure its parallelism with the bed during its action, there is a connecting rod, jointed at each end of it, which rods extends upwards and are jointed to the ends of two levers, which two levers have their fulcra in the cap of the press, their inner ends being connected together by a jointed link.

The second improvement is in the employing of an air vessel with a large force pump to be used in the commencement of the operation of pressing, and before great force is required; the latter part of the pressing is to be effected with a small pump without the air vessel.

Claim.—"What I claim is, first, the manner of combining the follower of the press with its head, or cap piece, by means of two lever beams, and their connecting rods, arranged and operating in the manner, and for the purpose, set forth; and, secondly, I claim the combining with the force pump of the hydrostatic press an air chamber, the air in which shall be compressed in proportion to the force with which the press is operating, and in such manner as that it shall, by its reaction, gradually diminish the quantity of water raised from the reservoir and thus graduate the action preparatory to the operation of a smaller or more powerful force pump, as herein made known."

18. For an improvement in *Mill Stones;* Pendleton Cheek, Flat Rock, Henry county, Georgia, August 21.

The improved mill stones are to have furrows cut on their faces of sufficient depth to admit of a free current of air, to keep the flour or meal cool; this constitutes the whole novelty, if novelty it be.

Claim.—"What I claim as my invention and desire to secure by letters patent, is the cutting of ventiducts, or ventilators, in mill stones, which will admit the free circulation of the air between the runner and bed stone, thereby keeping them cool and free from heating, burning, or killing the meal or flour in the act of grinding, using for that purpose any ventiducts, ventilators, or narrow deep furrows, as described."

19. For an improvement in *Venetian Shutters or Blinds;* John Hampson, New Orleans, Louisiana, August 21.

The device which is the subject of this patent is intended to regulate the turning of the slats of the blind; to retain them in any position, and to prevent them from rattling when used in carriages, railroad cars, &c.

In the grooved cheeks which receive the ends of the slats, there is arranged a set of springs which press a narrow strip against the ends of the slats and thus keep them in place.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method herein described of preventing the slats from rattling, and retaining them in any position in which they are placed by means of the movable strip pressed up by springs, or other other elastic substance, as described."

20. For an improvement on the *Steelyard;* Eli Willemin, Leesburg, Carroll county, Ohio, August 21.

The fulcrum pins, or knife edges, that receive the loops of the hooks, in the improved instrument, are attached to rings that turn on the steelyard, or lever, instead of being attached to the steelyard itself. These rings are retained in their places lengthwise by means of flanches, or other known means. Instead of being made flat and having only one or two edges notched and graduated to receive weights, as in the common steelyard, this instrument is to be made square, and is graduated and notched on three sides to receive the weights, by which the capacity of the apparatus is increased; either of the notched angles may be turned uppermost.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of revolving fulcrums to steelyards and balances, by means of which the same steelyard, or balance, may be made to weigh any quantity small or great."

21. For an improvement in the machine for *Raising and Moving Buildings;* Lewis Pullman, Portland, Chatauque county, New York, August 21.

The trucks which are to be employed for removing houses are to consist of an axle having a bolster provided with a pivot, on which the body to be moved rests, the trucks are to be furnished with holes, or mortises, in their peripheries to receive hand spikes by which they are to be turned. The apparatus for raising a building, &c., consists of a frame in which there is a screw that works a sliding nut, and from this nut are suspended hooks to catch on to the lower part of the house.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the pivot and bolster referred to, with the truck employed, for removing buildings and other weights, consisting of an axle and wheels having mortises on their peripheries to which levers are adapted for moving them. Also in combination with said truck, the screw having a movable nut, with hooks attached to it, for raising buildings, as described."

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22. For an improvement in the *Moulds for pressing Glass;* Hiram Dillaway, Boston, Massachusetts, August 21.

This improvement in the mode of pressing glass consists in making that part of the mould, or moulds, which forms the inside of the mould, to communicate with a reservoir containing a large body of the melted glass, so that the pressure shall be applied to the said large mass.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the formation of the mould for pressing glass in such a manner that the hollow form, or forms, into which the articles to be manufactured or pressed shall communicate with a larger fountain filled with melted glass, so that the forms may be filled by pressure applied to the mass of melted glass in the fountain."

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23. For improvements in the *Cut-off Valves of Steam Engines;* Horatio Allen, New York city, August 21.

The patent here named was granted for improvements on the cut-off valves patented by Isaac Adams, on the 17th of May, 1838, and noticed in this journal, vol. xxiii, second series, page 237, to which the reader is referred for a description of the original; which will enable him fully to understand the following claims, viz.

"What I claim in a patent for an adjustable cut-off is as follows: 1st. I claim the combination of two independent cut-off slides, adjustable on the same rod, to be used instead of the single cut-off slide as employed in the combination patented by Isaac Adams, May, 1838, the two acting on top of the slide valve with apertures, as described in said patent, but I do not claim the slide valve with apertures; and consequently this part of my adjustable cut-off, is for an improvement on Adams' cut-off, whereby his cut-off is made an *adjustable cut-off.*

"2nd. I claim the arrangement herein denominated cut-off, with fixed seats and adjustable slides wherein two independent cut-off slides are combined with two fixed seats, one for each end of the cylinder, and each containing an opening for the passage of steam to its respective end; said slides being adjustable on the rod carrying them, and driven by an eccentric, or cam, on the engine shaft, or by the reciprocating motion of the cross head suitably reduced, all as described.

"3rd. I claim the manner in which the two cut-off slides are made simultaneously adjustable by means of right and left hand screws on the rod carrying them, as described.

"4th. I claim the arrangement and combination for turning the rod carrying the slides, by means of a nut, or cog wheel, through the axle of which the rod passes, and is free to have a reciprocating motion lengthwise, but with which the rod must turn when the nut, or wheel, is turned, as described.

"5th. I claim the arrangement herein denominated "cut-off with adjustable seats," wherein a cut-off slide, or two cut-off slides, on the same rod are combined with two adjustable seats, one for each end of the cylinder, and each containing an opening for the passage of steam to its respective end. The cut-off slide, or slides, being permanently attached to the rod carrying them, and driven by a cam, or eccentric, on the engine shaft, or by the reciprocating motion of the cross head of the piston, suitably reduced for the required movement of the slides, and the seats being simultaneously adjusted by levers from a common shaft, or by a pinion acting on a rack from each seat or by the action of right and left handed screws or a rod passing through and carrying both seats, as described."

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24. For a method of *Preventing the Wheels of Locomotives from Sliding* on Railroads; Jordan L. Mott, New York city, August 28. (See specification, vol. ii, 3rd series, p. 348.)

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25. For an improvement in the *Spring Seats of Riding Saddles;* Thomas Mardock, Liberty, Union county, Indiana, August 28.

The claim in this patent is confined to the peculiar mode of affixing and forming the spiral spring, called by the patentee the "jewsharp spiral spring," and which is made out of a single piece of wire; but the formation of it could not well be understood without drawings, and these we deem it unnecessary to give. In this as in other spring saddles, one end of the spring is attached to the pummel, and the other to the web which is secured to the cantle of the saddle tree. The spring is easily constructed, at little cost, and will, no doubt, operate well.

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26. For a machine for *Folding and Measuring Cloth;* Joel Spalding, Morristown, La Moille county, Vermont, August 28.

The cloth to be folded by the above named machine, is first wound on to a roller which is placed in bearings in the upper part of the frame, from thence it is brought down to a table, or bed piece, provided with two hinged retaining bars, one at each end, under which the cloth, as it is folded, is caught and held, alternately at opposite ends. There are two folding boards, one at each end, and which are hinged to pendulous levers. The end of the cloth being secured under one of the retaining bars, the edge of the folding board, on that side, is pressed against it, and pushes it across the table to the other retaining bar, which is lifted up to receive, catch, and retain the cloth, whilst the folding board on the other side performs the same operation. The pendulous levers, to which the folding boards are attached, are so connected together as that whilst one board is folding the cloth the other is being prepared for the returning operation.

Claim.—"I shall claim spreading and folding the cloth upon the surface of the table, or bed piece, in regular layers of equal lengths, as described, by means of the above described arrangement of folding boards, having a reciprocating motion, in combination with the retaining bars, operated by said folding boards, through the intervention of the lifters and levers, the whole being constructed as described."

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27. For an improvement in the *Mortise* Latch for Doors, Carriages, &c. &c.; Leonard Foster, Boston, Massachusetts, August 26.

The bolt of this latch has a long slot towards its inner end, which fits into the square spindle of the knobs, so that it can slide on it, and its outer end be lifted up by turning the knobs. There is a thumb knob attached to this bolt on its inner side, the shank of which plays loosely in a mortise in that part of the door through which it passes, the lower edge of the said mortise being provided with two or three notches into which the shank of this knob fits. By this arrangement it will be perceived that by lifting the shank of this thumb knob out of one of these notches and pushing it, (together with the bolt,) to the second or third notch, the outer end of the bolt is pushed into the hasp on the jamb of the door, and thus locked. And there being no corresponding knob on the outside it cannot be unlocked, or lifted out of the notch, except by a key, which acts upon it in the usual way; the shank of the small knob and the notches in the mortise answering the purpose of the common tumbler.

Claim.—"What I claim as new in my improved trinity mortise lock, is the manner in which I have arranged and combined the respective parts thereof so as to cause it to answer the triple purpose of a latch, a bolt, and a lock; that is to say, I claim the forming of the latch bolt with a slot, or mortise, through it to admit of its sliding back and forth upon the square shank of the knobs, or handles, whilst it is capable of being raised as a latch by said handles, and this I claim in combination with the arrangement by which the thumb knob is connected with the latch bolt, on the inner side of the door, the shank of which knob is made to operate in an opening substantially like that described; and is so constructed, also, as to be operated on by a key on the outer side of the door, in the manner described; the catch, mortises, and other parts, being likewise arranged and operating substantially in the manner described. I claim, also, the mode of applying the said latch bolt to sliding doors by modifying the same to adapt it to this purpose."

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28. For an improvement in the *Caboose, or cooking Stove;* Michael Rocher, city of Nantes, in the kingdom of France, August 28.

The object of this improvement is to adapt the caboose used on board of ships, or other vessels, to the purpose of distilling salt water. The caboose is divided, by a diaphragm, into two compartments, an upper and a lower; the lower one contains the fire chamber and oven, which are surrounded by the salt water chamber, extending all around and over them, and the upper compartment forms a steam chamber, into which the kettles, &c., for cooking extend. A tube rises from the middle of the diaphragm to a considerable height in the steam chamber to convey the steam from the salt water compartment to the steam chamber, from which it is conducted by a pipe to the refrigerator, in which there is nothing peculiar.

Claim.—"What I claim as constituting my invention, and which I desire to secure by letters patent, is the dividing of the caboose, or cooking apparatus, into two compartments, the uppermost of which is to constitute a steam chamber, which is separated from the lower compartment, or boiler, by the diaphragm, or bottom, the two parts being combined with each other and with the condenser, substantially in the manner and for the purpose set forth."

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29. For a *Self-acting Feeder, for Supplying Steam Boilers;* Ethan Campbell, city of New York, August 28.

In this feeder the supply of water to the boiler is regulated by two floats, one in the boiler and the other in a feeding cylinder, or reservoir. The upper part of the boiler communicates with the upper part of the feeding cylinder by a pipe governed by a valve, connected with the rod of the float in the feeding cylinder, for the purpose of admitting the steam to press on the top of the water therein. The stem of this float is also in connexion with another valve which regulates the admission of water to the feeding cylinder, which is connected with the boiler below the water line, by means of a pipe provided with two lifting, conical valves, one of which is operated by a lever that is attached to the stem of the float in the boiler. When the reservoir has a sufficient supply of water, the float is borne up in it, which keeps the valve in the supply pipe closed, and that in the steam pipe open, thus admitting and equalizing the pressure of the steam on the water in the two vessels. In this condition the apparatus is in readiness to supply water to the boiler when it becomes necessary. When the water in the boiler sinks too low, the float following it, the valve in connexion with this float is opened, and as the other valve in the same pipe opens upwards, the head of water in the reservoir being higher than in the boiler, and the steam pressing equally on both, this valve is opened and the water flows into the boiler until it reaches the level of the water in the reservoir which closes the valves and stops the supply; and the discharge of the water from the reservoir causes the float therein to sink, and to close the valve in the steam pipe and open the one in the supplying pipe.

The claim is to the mode of combining the operation of the float in the reservoir, and the valves in the steam and supplying pipes, with the float in the boiler, and the valves in the pipe which conducts the water to the boiler.

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30. For an apparatus for *Rectifying Spirits;* Augustus V. H. Webb, city of New York, August 28.

Claim.—"I do not claim, as my invention, rectifying spirits, or whiskey, by means of carbonate of potash, chloride of calcium, or any other chemical agent having a strong affinity for water, the same having been already employed for this purpose. But what I claim as my invention, and desire to secure by letters patent, is the manner in which I employ the substances referred to for this purpose, in connexion with the cylinders and reservoirs attached to them; that is to say, I claim rectifying ardent spirits by means of one or more vertical cylinders filled with a substance having a strong affinity for water, through which the liquor is allowed to filter, combined with the reservoirs on which said cylinders rest, provided with separate faucets for letting off the water and alcohol, as described."

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31. For an improvement in the manner of combining *Elevated Ovens* with Cooking and other Stoves; Samuel B. Spaulding, Brandon, Rutland county, Vermont, August 28.

The patentee says—"In my improved mode of attaching elevated ovens to stoves, the ovens themselves are of the same kind with those in ordinary use, and which are constructed either in an oval, or cylindrical, form. In adapting the elevated ovens to stoves not originally intended to have them appended thereto, I construct what I denominate a connecting pipe, which is of a peculiar form; the lower end of it has an opening of such size as to fit on the collar, or rim, of the stove, to which the stove pipe is ordinarily fitted. The upper end of this connecting pipe, which is to be attached to the lower side of the oven, is widened out so as to embrace two openings which lead from it into the flue that surrounds the elevated oven; through these openings the heated air from the stove passes into said flue at a suitable distance from the centre and ends of the oven to insure the regular diffusion of heat. When the elevated oven is not to be used, and it is desired to carry the heated air directly to the exit pipe, it is made to pass along a flat flue which encircles one half of the oven, the course of the draught being governed by means of suitable dampers. By means of this flat flue the apparatus is rendered peculiarly compact."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner herein described of combining the elevated oven with the stove by means of a connecting pipe, constructed and arranged in the manner set forth; that is to say, having an opening at its lower end adapted to the neck, or collar, of the stove, and widening out at its upper end so as to embrace the two openings leading into the oven flue. I also claim, in combination with the foregoing, the flat flue leading from the connecting pipe to the exit pipe, and embracing the outer case of the oven in its passage, said flue being furnished with a valve, or damper, which, in combination with the other valves, or dampers, will govern the passage of the heated air from the stove, or through the flue, at pleasure. The whole apparatus being constructed, combined, and arranged substantially in the manner made known."

Practical & Theoretical Mechanics & Chemistry.

Mr. Mallet's *Processes for the Protection of Iron from Oxidation and Corrosion, and for the Prevention of the Fouling of Ships.*

[CONTINUED FROM PAGE 211.]

2. *The Palladiumizing Process.*

The articles to be protected are to be first cleansed in the same way as in the case of zincing, namely, by means of the double salts of zinc and ammonia, or of manganese and ammonia; and then to be thinly coated over with palladium, applied in the state of an amalgam with mercury.

[The directions given as to this process are meagre, in comparison with those supplied for the other processes; but we are informed that the protection afforded by the palladium is as absolute as that by the zincing, and by no means so costly as to exclude it from economical use.]

3. *The Zoofagous Paint.*

After the iron vessel has been zinced and varnished, in the manner before described, it is done all over (above the varnish, of course,) with a strong bodied thick paint. This is composed of drying linseed-oil, red lead, and sulphate of barytes, (or white lead may be used, but not so advantageously,) and a little turpentine. To every 100 lbs. of these ingredients, when mixed, is to be added 20 lbs., or thereabouts, of oxychloride of copper, and three pounds of a mixture composed of hard yellow soap melted with an equal weight of common rosin, and a little water. The colour originally sold in commerce under the name of "Brunswick green," was an oxychloride of copper; but the present Brunswick green of commerce is a different thing, and will not answer. The oxychloride of copper may be obtained at a cheap rate, by various known methods, which it is unnecessary to detail. When the whole of the hull of the vessel has been done over with the paint, it must be permitted to dry and harden for three or four days, before the ship is floated out of dock. The entire series of operations are now completed; and the hull of an iron ship so treated will, Mr. Mallet assures us, "resist all corrosion from the action of air and fresh or sea water, and not be liable to 'fouling,' by the adhesion of marine animals and plants."

Mr. Mallet adds, that the power of the zoofagous paint to prevent 'fouling' arises from the fact, that the insoluble, or difficultly soluble salts of copper, and of certain other metals, are so noxious to the life of marine, or aquatic, animals and plants, which generally attach themselves to ships' bottoms, that they will not adhere or grow upon a surface so treated. The paint, therefore, is only a vehicle for poisonous matter, for which purpose it is requisite that it should have sufficient adhesion to resist the ship's motion, but still should have a slight degree of solubility in water, so that the poisonous matter may be taken up by the absorbent or capillary vessels of any adhering animal or plant. This latter property is given it by the addition of the resinous soap, the proportion of which should be varied to suit the climate to which the ship is going, more being used in frigid, and less in tropical climates. Mr. Mallet prefers using the oxychloride of copper, and has found it by much the most efficacious; but any insoluble, or difficultly soluble, salt of copper, mercury, arsenic, or antimony, or any combination of these, whether soluble or insoluble, may be substituted for it.

General Observations.

Although Mr. Mallet deems it *advisable* that where new ships are intended to be protected by zincing, the iron should go through the whole of the processes before directed, namely, the cleansing, the coating with the triple alloy, the varnishing, and the final coating with the zoofagous paint, he remarks that they are not all equally essential, and points out how the same effects may be produced, though attended with less favourable circumstances, by the adoption of a part only of these processes:

"For, supposing the plates and ribs of iron were merely coated with the triple alloy of zinc, mercury, and potassium, or sodium, without the addition of the protective varnish and zoofagous paint, it is certain that, on the exposure of this alloy to the action of air and water, the positive metal at the surface would be first acted on, and the surface become shortly covered with a very thin coat of amalgamated zinc, which is known not to be acted upon by fluid menstrua, (except under peculiar conditions which do not exist in the case here supposed,) and does not, as I have found by experiment, gather to itself, when exposed to sea or fresh water, any of that calcareous coating which is productive of the fouling of vessels. The advantage gained by varnishing over this triple alloy coating is of a twofold nature. In the first place, it serves as a mechanical protection to the coating, and thereby to increase its durability; and, secondly, it shields the alloy from contact with the zoofagous paint, some of the ingredients of which would exert an injurious chemical action on the alloy. The office, therefore, of the triple alloy is simply to prevent corrosion and oxidation, (including, where used by itself, that of preventing the formation of calcareous adhesions;) that of the varnish, to protect the triple alloy; and that of the zoofagous paint, to prevent fouling, by the destruction of any marine animals or aquatic plants which may seek to attach themselves to the protected surfaces."

When the addition of the zoofagous paint is not required to prevent fouling, as in the case of articles exposed to the action of the atmosphere only, Mr. Mallet states that any desirable colour may be given to the protecting varnish, by a mixture of colouring materials, but that care must be taken that these colouring materials consist of peroxides not liable to be acted on by air or moisture. The best method to adopt, however, with such articles, is said to be, to pay the varnish all over with a coat of oil paint.

Finally, although the triple alloy is directed in the first instance, to be employed at the fusing temperature, Mr. Mallet states that, by the addition of a larger portion of mercury, articles of cast or of wrought iron or steel may be coated with that alloy at a lower temperature, and even in a cold state, by means of simple contact and friction.

Mech. Mag., Jan. 1842.

On the Existence of Sulphur in Plants.

M. Vogel, Sen., remarks, that it has been proved by the late M. Planche and other chemists, that many plants contain sulphur. Water cresses, *Lepidium sativum*, L., are among those which especially contain much sulphur.

As soils distant from volcanoes do not contain perceptible traces of sulphur, it appears to M. Vogel not impossible that plants, which are much disposed to assimilate sulphur, may have the property of deriving it from the decomposition of the sulphuric acid of sulphates. M. Vogel, however, found that seeds placed in a soil perfectly free from sulphur and sulphates, yielded plants which contained a notable quantity of sulphur.

The soil employed for this experiment consisted of coarsely powdered white glass; it was first strongly heated, but not fused, in a crucible, and being afterwards washed with boiling water, not the slightest trace of any sulphate could be detected.

Seeds of water cresses kept in a moist state were placed in this, and when the plants were several inches in height, they were removed with their roots; after having washed the plants, the white fibrous roots were cut off, and these as well as the plants were dried, and on heating them in a retort, it was found that both of them yielded considerably more sulphur than the seeds contained; the expressed juice of the young plants cultivated in the powdered glass also contained soluble sulphates. The seeds of water cresses, sown in coarsely powdered quartz, flint glass, and very fine silica, obtained from silicated hydrofluoric acid, yielded similar results with respect to sulphur and sulphates, though the plants did not flourish so well in the last as in the two former substances.

To obtain approximative results as to the quantity of sulphur in the water cress seeds and the plants which they yielded, the following experiments were made:—The seed [100 grains?] was heated to redness in a retort, and the gases disengaged were received into a solution of potash; acetate of lead was added to the alkaline liquor as long as precipitation occurred. The precipitate was of a brownish colour, and consisted of hydrate, carbonate, and sulphuret of lead; the two former were dissolved by dilute nitric acid, and the sulphuret of lead remained, which, after washing and drying, weighed 0.95 gr., which indicated 0.129 gr. of sulphur. According to this experiment, 100 grs. of the seed contained 0.129 gr. of sulphur.

The young plants obtained from the growth of 100 grains of the seed were similarly treated; their weight was 2040 grs.; they yielded by the above described processes 15.1 grs. of sulphuret of lead, equivalent to 2.03 grs. of sulphur: consequently the dried plants contained nearly fifteen times as much sulphur as the 100 grs. of seed which produced them.

Another experiment was made by projecting into a red-hot platina crucible small successive portions of a mixture of powdered cress leaves with nitrate and carbonate of potash. The residue, heated in the crucible and treated with nitric acid, gave a considerable precipitate with chloride of barium, but, on account of the sulphate of potash which the plant contains, the quantity of sulphur cannot be accurately determined by this process, although in general it is preferable to that above described; 100 grs. of the leaves yielded in this way 4.6 grs. of sulphate of barytes, equivalent to 0.624 gr. of sulphur; but the quantity of sulphate of potash is to be deducted from this.

As the growth of the young plants of water cresses took place in a soil devoid of sulphur and sulphates, and in a room which contained no sulphurous vapours, the origin of the sulphur, M. Vogel remarks, is to him a perfect enigma, and at present he confesses that he is unable to give a satisfactory explanation of it.—*Jour. de Pharm. et de Chim.*, Mai 1842.

Lond. & Ed. Philos. Mag., July, 1842.

Velocity of Water through Pipes.—Mr. Rofe's Experiments at the Birmingham Water Works.

The calculations are for the head of water necessary to keep up a given velocity for every 100 feet run of pipe. The tables were two: in the first V represents the table of velocities in feet per minute, and T the constant numbers for those velocities:

V	T
60	8.62
70	11.40
80	14.58
90	17.95
100	21.56
110	25.35
120	29.70
130	34.
140	38.90
150	44.
160	49.50
170	55.66
180	62.13

In the latter, D represents the diameter of the pipes in inches, and t the constant numbers for those diameters:—

D	t
3	
4	.028
5	.053
6	.078
7	.104
8	.134

As an application of these tables, the following problem was proposed; it having been premised that the formula for their use was—

$$\frac{T}{D + t} = H$$

where H represents the height, or head of water. It is required, then, to determine what head of water will be necessary to send water by an engine through 1,500 feet of six inch pipes to an elevation of 80 feet, at a velocity of 180 feet per minute. Now, by the table, we see that the constant number for 180 feet velocity is 62.13, and the constant number to be added to six inches is .078,

$$\text{and } \frac{62.13}{6.078} = 10.22 \text{ inches,}$$

which is the head of water required to keep up the velocity of 180 feet per minute for every 100 feet run; which, being multiplied by 15, (the number of hundred feet through which it has to pass,) gives 153 inches, or 12 feet 9 inches. This, added to 80 feet, will give 92 feet 9 inches as the column of water which the pump must lift.

Lond. Mech. Mag., May, 1842.

Description of the Tanks for Kyanizing the Timber for the permanent Way of the Hull and Selby Railway.

The apparatus consists of two tanks, a reservoir, two force pumps, and a double air pump. The tanks are cylindrical, with flat ends, and are made of wrought iron plates, nearly half an inch in thickness. They are 70 feet in length, and six feet in diameter. At each extremity is a cast iron door, flat on the outside, and concave on the inner side, provided with balance weights for raising and lowering it. Each end is strengthened by five parallel cast iron girders, whose extremities are held by wrought iron straps, riveted on to the circumference of the tanks. Notwithstanding the great strength of these girders, several were broken by the pressure applied during the process. The vessels are lined with felt, upon which is laid a covering of close jointed fir battens, fastened with copper rivets. This precaution is necessary to prevent the mutual deterioration which would arise from the contact of the iron and corrosive sublimate. There was originally only one brass force pump, two inches diameter, and six inches stroke. This being found insufficient, another was added of four inches diameter, and henceforward a pressure of 100 lbs. per square inch was easily obtained. The air pump is ten inches diameter, and fifteen inches stroke. Its construction is of the ordinary kind. The author gives, in an appendix to the paper, a minute description of the various parts of the apparatus, with the details of their dimensions and weight. The process is simple and rapid; the corrosive sublimate is first mixed with warm water in a trough, in the proportion of one pound of the former to two gallons of the latter; the clear solution is then poured off into the reservoir, where water is added till it is diluted to the proper point, which may be ascertained by a hydrometer. A more perfect test is the action of the solution upon silver, which it turns brown at the requisite degree of saturation. The operations of exhaustion and pressure employ eight men for five hours, the whole process occupying about seven hours, during which time from 17 to 20 loads are kyanized in each tank. It is desirable that the timber should remain stacked for two or three weeks after kyanizing, before it is used. It was found that about three-quarters of a pound of corrosive sublimate sufficed to prepare one load (50 cubic feet) of timber. About 337,000 cubic feet of timber were kyanized, the average expense of which, including part of the first cost of the tanks, was about 5*d.* per cubic foot. The timber was tested after the process, and it was found that the solution had penetrated to the heart of the logs.

Ibid.

Action of Salts on Living Plants.

From the various experiment which M. Vogel, Sen., has made on the action of salts on living plants, he has arrived at the following conclusions:—

1st. That plants with their roots when immersed in a solution of sulphate of copper, totally absorb the salt, convert it into proto-sulphate, and die quickly.

2nd. That acetate of copper produces the same effects, the salt absorbed becoming proto-acetate of copper.

3rd. That plants absorb sulphate of magnesia, nitrate of potash, and iodide of potassium, and die more or less quickly.

4th. That the sulphates of zinc and manganese are absorbed by plants without suffering decomposition, and the plants die.

5th. That plants absorb nitrate of cobalt and nickel, without being able to absorb the whole of them from solution; but they die, and the same effect is produced by emetic tartar.

6th. That the oxalate and tartrate of oxide of chromium and potash are slowly absorbed by plants, and the bichromate of potash much more quickly. The *Datura Stramonium* and *Galega officinalis* absorb the salt of chromium with the greatest rapidity; they become of a yellow colour and die.

7th. That plants absorb nitrate of silver; but they decompose it, and the oxide of silver is reduced to the metallic state.

8th. That plants absorb also, and totally, the protonitrate of mercury from solution, but the salt is decomposed.

9th. That corrosive sublimate is absorbed by plants; some of them decompose it into calomel, and others absorb it without decomposition.

10th. That plants slowly absorb acetate of lead; and it is decomposed by some plants and not by others.

11th. That plants which contain much carbonate of lime, such as the *Chara vulgaris* and the *Stratiotes aloïdes*, do not absorb a salt of copper from solution: the same also occurs with the *Cereus variabilis.—Jour. de Pharm. et de Chem.*, Mai 1842.

Lond. & Ed. Philos. Mag., July, 1842.

Method of Distinguishing between weak Solutions of Nitrates and Chlorates. By M. Vogel, Jr.

When a few drops of tincture of litmus are added to a solution of nitrate of potash so as to render it blue, and afterwards concentrated sulphuric acid, the tincture is merely reddened by the sulphuric acid, and by the nitric acid set free, but it is not at all decolorated. A solution of chlorate of potash, on the contrary, which has been rendered blue by tincture of litmus, is entirely decolorated by the addition of concentrated sulphuric acid, a result by which the chlorate is effectually distinguished from the nitrate.

This effect is produced with the chlorate when one part is dissolved in sixty-four parts of water, but it ceases with eighty parts of water; but a solution of indigo is decolorated when water contains only $\frac{1}{500}$th of its weight of chlorate of potash.

This method of distinguishing the chlorates from the nitrates, both in very dilute solutions, has besides the advantage of giving certain results, in decolorating the tincture of litmus, even when the chlorates are accompanied with chlorides and other salts.

Tincture of litmus is not decolorated by a very weak solution of nitrate of potash on the addition of sulphuric acid, even when some hundredths of common salt or of other chlorides are present: it is decolorated only when the nitrate of potash is dissolved in a concentrated solution of common salt.—*Ibid.*

Ibid.

Method of Lowering the "Lights" in some particular Engravings executed in the Wood-cut manner.

Sir.—I here submit a new method of lowering the "lights" on the surface of some particular engravings executed in the wood-cut manner, as, for instance, the copper blocks produced by electrography, and those formed by Mr. Woone's stereotype process: the lines of the pictures in both styles being all one height, on account of the design being engraved on a flat, even surface. The metal casts or blocks are first "stopped" out in the darkest tint by the application of a hair pencil dipped in some strong varnish, as that of copal, asphaltum, or seed-lac, the first mentioned being the most preferable; and then attached to and immersed as positive plate in the single-cell voltaic apparatus used in electro-metallurgic experiments, letting it remain until the parts untouched with varnish have been corroded to the requisite depth. It should then be taken out, dried, and the varnish brush applied to those portions which may be considered deep enough, repeating alternately the varnishing and corrosion, until the cut is graduated to your desire. The character of the engraved lines will not be much injured by the electro-etching process, as the corrosion proceeds with evenness and regularity. The more simple application of nitric or other suitable acid, might probably be found efficacous when the design is of a bold or rude character, and strongly lined.

As a mode of lowering blocks of the above description for typographic printing has long been sought for, the insertion of this little hint may be of service to some of the readers of the Mechanics' Magazine. I have the honour to be, your obedient servant,

M. T. Brazendale.

Lond. Mech. Mag., May, 1842.

Number of Furnaces in Great Britain.

We are enabled this week to furnish a tabular statement, showing the number of furnaces in and out of blast in the United Kingdom, with the weekly "make," in most instances taken from data on which no question can arise as to the accuracy of the returns, while in other cases, we have adopted such estimates as appeared to us, from the information derived, to be sufficiently near for the attainment of the object in view—that of presenting to our readers a complete table, wherein the several iron works of the United Kingdom are classified, with the names of the proprietors, and the weekly product, as also the aggregate returns.

The following summary will at once exhibit the present position of the iron trade:—

	No. of furnaces.	In blast.	Av. weekly make.
South Staffordshire, 1st div.	87	54	4200
" 2d div.	48	32	2475
North Staffordshire	18	12	620
Shropshire	36	24	1355
Derbyshire	15	14	577
Yorkshire	30	24	1059
Scotland	91	65	5525
Northumberland	7	2	120
Durham	2	2	120
Forest of Dean	8	3	120
South Wales	162	112	9000
North Wales	21	6	360
Ireland	2	—	—
Total	527	350	25,531

It will be thus seen, that the number of furnaces in the United Kingdom is 527, of which 350 are in blast, and 177 out of blast, the quantity of pig iron made, or capable of being made, at the present time (by the furnaces in blast,) being 1,327,612 tons per annum, from which, however, we may deduct 20 per cent.—leaving 1,062,090 tons as the actual make. On comparing this statement with an abstract of the quantity of pig iron estimated to have been manufactured in the year 1839, and which is embodied in Mr. David Mushet's work, entitled *Papers on Iron and Steel,* we find the average weekly make at that period to have been as follows:

	Furnaces.	In blast.	Av. weekly make.
South Staffordshire	126	106	6660
North Staffordshire	10	7	350
Shropshire	34	29	1555
Derbyshire	16	14	660
Yorkshire	29	24	1010
Newcastle-on-Tyne	5	5	250
Scotland	54	54	3790
Forest of Dean	8	5	350
South Wales	127	122	8730
North Wales	20	13	650
Total	429	379	24,005

or an annual make of 1,248,260, which is called in Mr. Mushet's work 1,248,781 tons. It will be thus seen, that, comparing the present make with that of the average of 1839, the number of furnaces in that year was 429, of which 379 were in blast; whereas, in February, 1842, the number had increased to 527, of which only 350 were in work, the majority being at a reduced make of 25 per cent.—the aggregate quantity made weekly being, in 1839, 24,005 tons, and in February, 1842, 25,531 tons—there being an increase, in the past two years, of 98 furnaces, equal to an additional make of 407,680 tons per annum (about one-third the average make,) while the number of furnaces in blast in 1839 was greater than those enumerated as being in operation at the present time.

We do not propose entering further into the subject, but having collected that information, which is not only interesting, but valuable, as statistical detail, we leave to our correspondents to furnish such additional particulars as they may possess, having, so far as lies in our power, devoted our attention to the subject.

Mining Jour., March, 1842.

METEOROLOGICAL OBSERVATIONS FOR JULY, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P. M.	Baromtr. Sun Rise	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	70°	87°	29.90	29.90	SW.	Moderate	.70	Par. cloudy.	Par. cloudy; shower
	2	72	82	29.96	29.96	W.	do	.26	Par. cloudy.	Par. cloudy; shower.
	3	72	80	30.00	30.00	SW.	Brisk	.15	Cloudy.	Cloudy; shower.
	4	71	82	30.00	29.96	S. SW.	Moderate		Cloudy.	Cloudy.
	5	71	80	29.96	29.96	SW.	do		Cloudy.	Cloudy.
	6	72	71	29 80	29.83	SW.	do	1.92	Cloudy.	Showers.
	7	61	73	30.00	30.05	SE.	do		Cloudy.	Clear.
⊗	8	66	75	30.00	29.95	SE.	do		Cloudy.	Cloudy.
	9	72	76	29.85	29.85	W.	Brisk	1.85	Cloudy.	Shower.
	10	65	72	29.95	30.00	NW.	Moderate		Cloudy.	Cloudy.
	11	63	77	30.00	30.05	E.	do		Clear.	Clear.
	12	62	80	30 05	30.00	E. SE.	do		Cloudy.	Clear.
	13	64	83	29.90	29.90	SE.	do		Fog.	Clear.
☾	14	72	83	29.80	29.80	S.	do		Cloudy.	Partially cloudy.
	15	65	64	29.80	29.80	NE.	do		Cloudy.	Cloudy.
	16	62	66	29.80	29.80	NE.	do	1.90	Rain.	Rain.
	17	63	80	29.77	29.80	N.	do		Clear.	Clear.
	18	68	82	29.78	29.78	E.	do		Lightly cl'dy	Lightly cloudy.
	19	70	86	29.78	29.78	SW.	do		Lightly cl'dy	Clear.
	20	69	82	29.78	29.85	W.	do	.15	Shower.	Partially cloudy.
	21	60	78	30.10	30.10	E.	do		Clear.	Clear.
☺	22	62	78	30.15	30.15	S. SW	do		Clear.	Clear.
	23	70	83	30.15	30.15	SW.	do		Cloudy.	Clear.
	24	72	83	29.93	29.93	SW.	do	.59	Cloudy.	Shower.
	25	66	74	30.05	30.15	W.	do		Clear.	Clear.
	26	63	82	30.10	30.04	W.	do		Cloudy.	Clear.
	27	68	87	29.94	29.94	SW.	do		Clear.	Lightly cloudy.
	28	72	84	29.90	30.00	E.	do	.38	Par. cloudy.	Rain.
	29	72	82	30.00	30.00	SE.	do	.03	Cloudy.	Clear; rain.
☽	30	73	86	29.85	29.80	W.	do		Clear.	Clear.
	31	76	87	29.70	29.70	SW.	Brisk		Par. cloudy.	Cloudy.
		67.87	79.52	29.93	29 93			7.93		

Thermometer.		Barometer.	
Max. 87.00 on 15th, 27th &31st.	Mean, 73.695	Max. 30.15 on 22d, 23d & 25th.	Mean 29.93
Min. 60.00 on 21st.		Min. 29.70 on 31st.	

AUGUST, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P. M.	Baromtr. Sun Rise	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	54°	68°	29.90	29.95	W.	Moderate		Par. cloudy.	Par. cloudy.
	2	54	72	30.06	30.10	W.	do		Clear.	Clear.
	3	59	76	30.00	30.03	E.	do		Clear.	Flying clouds.
	4	62	70	30.00	30.00	NE.	do		Cloudy.	Cloudy.
	5	68	65	29.80	29.80	NE.	Brisk	.50	Rain.	Drizzle.
⊗	6	60	72	30.00	30.15	SE.	do		Cloudy.	Lightly cloudy.
	7	66	71	30.00	29.90	NE.	do	.25	Rain.	Showery.
	8	67	76	29.90	29.85	SE. SW.	do		Cloudy.	Lightly cloudy.
	9	68	74	29.90	29.93	W.	do		Cloudy.	Cloudy.
	10	68	78	29.88	29.90	NE.	do		Fog.	Cloudy.
	11	68	76	29.90	29.90	W.	do	.23	Rain.	Lightly cloudy.
	12	68	75	29.86	29.86	SE.	do	.05	Cloudy.	Cloudy; rain.
☾	13	67	76	29.85	29.90	E.	do	.07	Par. cloudy.	Rain.
	14	65	80	30.05	30.00	W.	do	..65	Clear.	Clear; shower.
	15	65	79	29.94	29.86	W.	do		Cloudy.	Hazy.
	16	64	80	29.90	30.00	SW.	do		Cloudy.	Hazy.
	17	70	75	29.90	29.90	SE.	do	.35	Cloudy.	Showery.
	18	73	84	29.83	29.80	SW.	do		Clear.	Clear.
	19	70	82	29.80	29.90	W.	do		Clear.	Clear.
☺	20	64	80	29.90	29.95	W.	do		Lightly cl'dy.	Clear.
	21	64	78	30.00	30.05	W.	do		Clear.	Clear.
	22	64	78	30.15	30.20	NE.	do		Clear.	Clear.
	23	63	75	30.20	30.20	E.	do		Clear.	Clear.
	24	66	74	30.10	30.20	E.	do	1.20	Cloudy.	Rain.
	25	72	79	29.83	29.83	SW.	Brisk		Cloudy.	Clear.
	26	73	82	29.83	29.83	SW.	do	.35	Cloudy.	Clear; shower.
	27	74	82	29.83	29.74	SW.	Moderate		Cloudy.	Flying clouds.
☽	28	71	78	29.74	29.65	W.	do		Cloudy.	Cloudy.
	29	71	83	29.65	29.66	W.	do		Clear.	Clear.
	30	64	75	29.70	29.96	E.	do		Clear.	Clear.
	31	60	77	30.10	30.10	SW.	do		Clear.	Clear.
		65.87	76.45	29.92	29.94			3.65		

Thermometer.		Barometer.	
Maximum 84 on 18th.	Mean 71.16	Max. 30.20 on 22d 23 & 24th.	Mean 29.93
Minimum 54 on 1st and 2nd.		Min. 29.65 on 28th & 29th.	

JOURNAL

OF

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OF THE

State of Pennsylvania,

AND

AMERICAN REPERTORY.

NOVEMBER, 1842.

Civil Engineering.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on Reaction Water Wheels used in the United States; and on the Turbine of M. Fourneyron, an Hydraulic Motor, recently used with the greatest success on the continent of Europe. *By* Ellwood Morris, Civil Engineer.

[CONCLUDED FROM PAGE 227.]

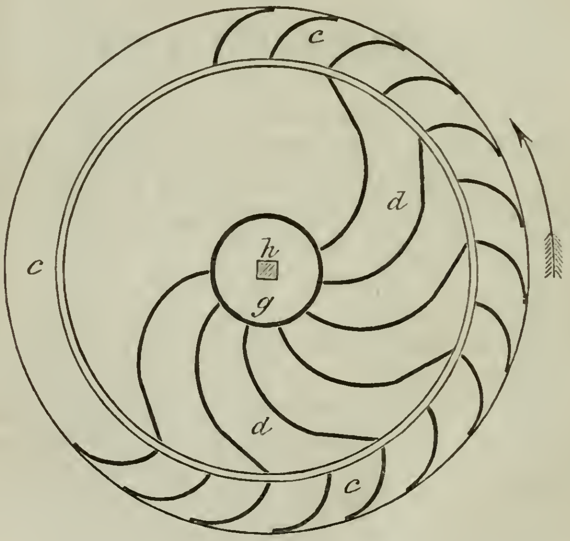
On Turbine Water Wheels.—Having completed our remarks upon *reaction water wheels,* by endeavouring to show *that they are not superior in effect to undershot wheels,* unless when acting in backwater; we will now proceed to consider the *turbine* of M. Fourneyron, which—whether employed upon falls as low as three feet, or as high as 354 feet—whether immersed in backwater or not—realizes continually, with remarkable uniformity, a proportion of useful effect *quite as great,* in comparison with a given power expended, as can be obtained from the best overshot wheels, working under the most favorable circumstances; in other words, whilst the co-efficient of effect belonging to the turbines, continually approximates to 0.800, it remains nearly invariable, under all circumstances of fall and position; this peculiar wheel possessing the remarkable property of being equally effective and suitable, in almost every situation where water wheels can be used as motors.

The *turbine,* or water wheel invented by M. Fourneyron, is like the reaction wheel, formed of cast iron, (often in a single piece,) and like it, is usually made to revolve horizontally about a vertical axis.

In the following sketches, *c c* represents a horizontal section of the wheel rotating in the direction of the arrow, about a vertical axis passing through a pipe attached to the *fixed disk d d;* which disk is surmounted by a series of *guides,* curved in a particular manner, whereby the water is conducted to the wheel, made to issue tangentially, and press upon the curved buckets perpendicularly, or nearly so, thus producing a revolving motion.

The admission of water from the upper level to act upon the wheel, is regulated by an annular sluice gate, which envelopes the curved guides, and shuts down upon the fixed disk; when this sluice gate is raised, the water issues out between the curved guides and turns the wheel; when closed, a water tight joint is formed, and none can pass to the lower level; all which will be easily comprehended, from an examination of the following description and diagrams.

Fig. I.



General Description of a Turbine.

Fig. I exhibits part of a horizontal section of a *turbine;* in which *c c c* shows *the wheel* turning in the direction of the arrows; *d d, the fixed disk,* with its curved guides attached, the spaces between which are the sluices whence the water issues, and presses upon the curved buckets of the wheel; *g, the shaft pipe,* which sustains *the fixed disk* in an unchangeable position upon its lower extremity, and is itself sustained at its upper end by the carpentry above the forebay; through this pipe *the shaft* of the wheel *h* rises to communicate motion to the works driven by *the turbine;* the open annular space between *d* and *c* represents the place of the sluice gate, which is a short portion of a thin hollow cylinder of cast iron, moving vertically, in contact with *the fixed cylinder n n,* at its upper part, and closing down water tight upon the fixed disk; wooden blocks are screwed upon the inside of the annular sluice gate, which slip between the curved guides and are rounded above and below, in order to improve the ajutage, and thus facilitate the efflux of the water, as is more clearly seen at *f* and *e*, Fig. II.

Fig. II.

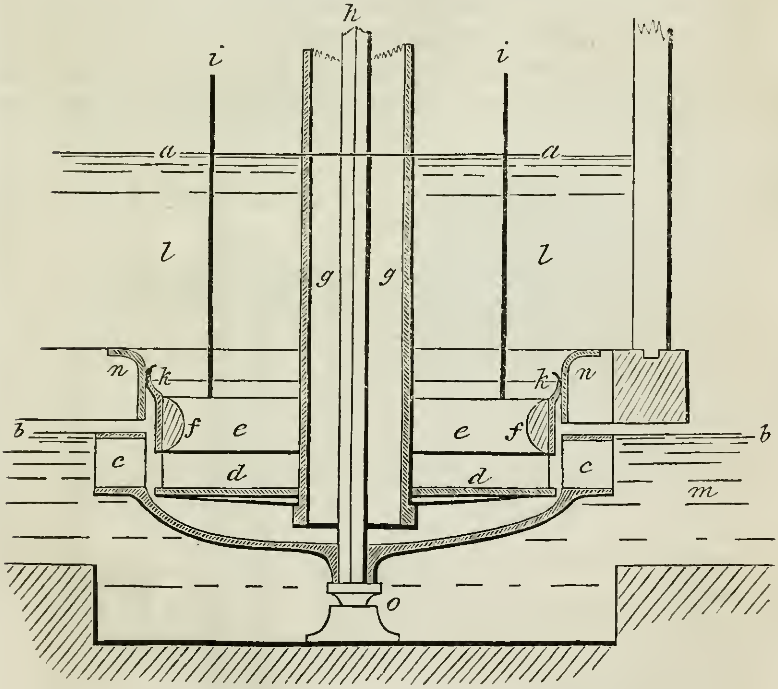
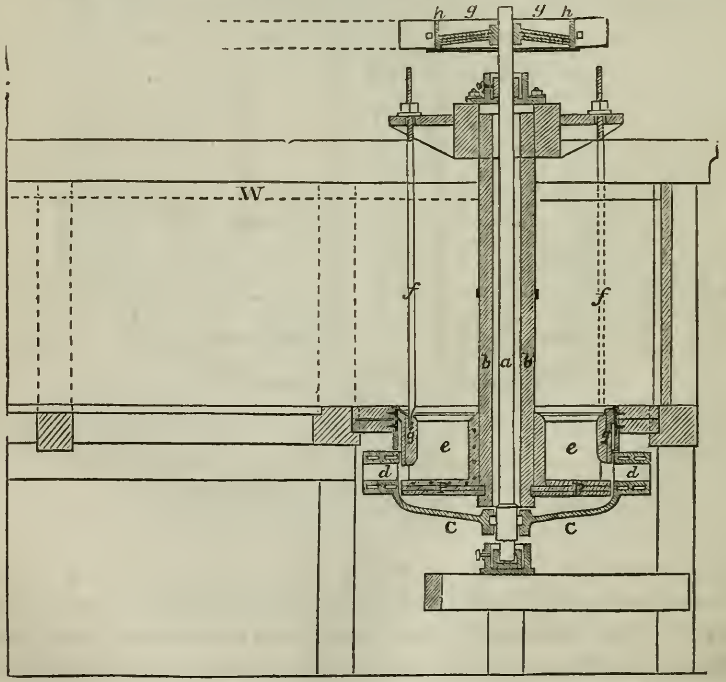


Fig. II exhibits a vertical section of a *turbine; a a,* the surface of water in the upper level, or forebay; *b b,* the surface of water in the lower level, or tail race; *c c, the wheel* with buckets curved in plan; *d d, the fixed disk* and *curved guides* firmly supported by *the shaft pipe g; e e, the annular sluice gate,* with its wooden internal cushions *f f,* to improve the ajutage; *g g, the shaft pipe; h, the shaft* upon which *the wheel c c* is firmly fixed at its lower part, so as to carry the shaft with it in its movement of rotation; this shaft runs upon a suitable step, or pivot, at *o: i i*, two vertical rods, which, with a third not seen in the sketch, are attached to the annular sluice gate at equal distances apart, and which being all acted upon equally by an arrangement of screws and spur gear, raise or depress the annular gate with perfect regularity; *k k*, *a leather collar*, extending entirely around the upper circumference of the annular sluice gate, which collar being pressed outwards by the water, against the concave surface of the concentric *fixed cylinder n n*, effectually secures this joint in a manner that prevents leakage; *l l*, *the forebay*, the water of which has free communication with the sluices of the turbine, by the whole circular space from *k* to *k*; and finally, *m* is the *tail race* through which the water escapes, after having actuated the turbine.*

To illustrate still more clearly the construction and mode of operation of the turbines, we subjoin a brief extract from a paper on this subject, by George Rennie, Esq., F. R. S.. &c., published in this journal for 1840, and also reprint the wood cuts accompanying that paper.

Fig. III. VERTICAL SECTION.



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* We will here observe that the curves of the buckets of the turbine, and of the guides upon the fixed disk, must be traced in a particular manner, which it requires some study to master; and that without a close attention to this point, these wheels *may fail* to realize a proper degree of useful effect, as was the case with several in France, which were not constructed with sufficient care.

Description of the Engravings.

L, beam with which the lever of the brake is connected by a spring balance marked D. W, water level. F, friction wheel. D, dynamometer.

a, Main axle of the turbine.

b b, Shaft pipe enclosing it

C C, The lower part, or shell, of the turbine wheel.

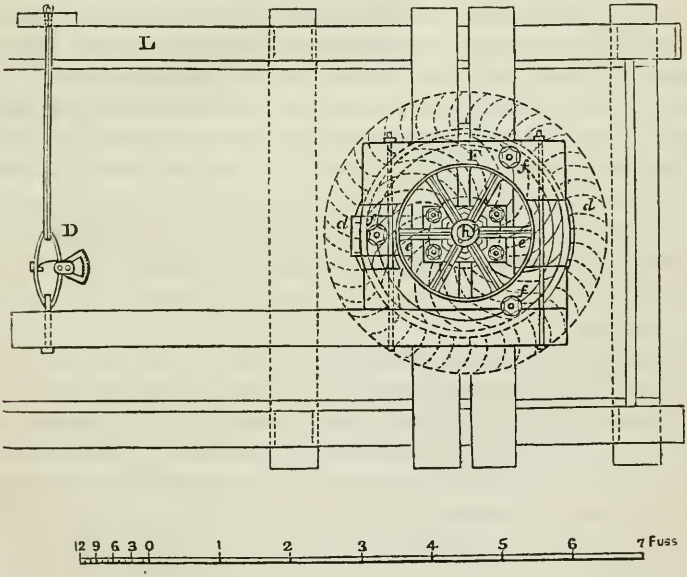
d d, The curved buckets, or vanes, against which the water presses in escaping between them from the wheel.

e e, The curved guides upon the fixed disk.

f f, Rods and screws for manœuvring the annular sluice gate.

g g, The annular sluice gate.

Top View. Fig. IV.



"*Operation.*—To set the machine in motion, the sluice *g g* is drawn up by means of the screws and bolts *f f*. Then the water which is continually resting on the fixed disk P P, with the pressure of the whole fall, immediately issues out between the curved guides, and impinging upon the curved buckets of the turbine, causes it and the main shaft, with all its machinery, to revolve rapidly."

Such is the description of Mr. Rennie, which is reprinted at the risk of repetition, with the particular purpose of drawing attention to the

Brake, or Friction Dynamometer, of M. De Prony, by means of which the useful effect of the turbine has been usually measured.

The *brake* consists simply of two stout pieces of wood, embracing a smooth wheel firmly fixed upon the shaft of the turbine, and cut out concave to fit, or nearly fit, this wheel; these collar beams are connected together, by two screws with heavy nuts and washers, by means of which they may be made to embrace the fixed wheel, with any necessary degree of force, or even to stop its motion.

To one of these beams, a long lever is attached, and connected at its outer end, either by a spring balance or a scale and weight, with some fixed point of the building.

This is the whole machine (see the sketches) which, as a dynamometer, is remarkably accurate, as well as perfectly simple; all that is necessary is, that the friction should be made regular, and the wooden collar beams prevented from burning; both these objects are effectually attained, by the simple precaution of causing a small stream of water to fall constantly upon the rubbing surfaces of contact.

Then the screws being set up with any moderate force, weights are added if a scale is used, or the spring dynamometer is made to act, so as to keep the lever fixed in a position perpendicular to the pull of the balance.

If, when the shaft is revolving with speed, the lever remains regulated by the balance weights applied, in the position above mentioned without much vibration, *the weight placed in the scale, (or indicated by the spring balance,) multiplied by the velocity the end of the lever would take if free to revolve,* will give a correct measure of the net useful effect of the machine.

It was with this simple and correct instrument, devised for such purposes by M. de Prony, that all, or nearly all, of the experiments made by M. Morin and others, upon the economical value of the turbine have been performed.

Comparison between Reaction and Turbine Wheels.

The wheel of the turbine alone, is not very dissimilar in general appearance to the reaction wheel, though totally different in its mode of action.

The difference lies in the addition of a fixed disk surmounted by curved guides, and in an entirely different curvature given to the buckets; these variations change the whole character of the machine.

The *reaction wheel* derives its motion solely from the *reaction* of the spouting water against very oblique vanes, so curved as to facilitate this spouting to the utmost extent; whilst the water is left free to take its own course, in entering the wheel.

In the *turbine*, on the contrary, the effect is to restrain, as much as possible, the spouting of the water at a high velocity, and force it to act against the vanes, or buckets, almost perpendicularly *by its pressure*, and not obliquely *by its impulse:* hence it is that the curved guides are established to conduct the effluent water, and constrain it to act tangentially against the vanes, which are curved around so much as to prevent the water from leaving them until its pressure is exhausted, or until, thrown outwards by centrifugal force, it drops from the wheel inert and almost destitute of motion.

In the *reaction wheel*, the greater the velocity of the spouting water the greater is the impulsive reaction, and consequently the greater is the effect produced—but in the *turbine*, the less the velocity of the effluent water, and the less its impulse, the greater is the effect, because its full pressure is then made to act with more advantage.

In fact the turbine is so planned as to satisfy, *practically*, the theoretical condition which the European philosophers have established as necessary to the production of a maximum effect in water wheels, viz: *that the water must enter the wheel without shock, and leave it without velocity*—or in other words, that it must be a wheel of pressure and not of impulse—which condition, fulfilled by the turbine, is not satisfied, but reversed by the reaction wheel; and hence it is that the latter ranks amongst wheels of impulse, and has an effective coefficient of only about 0.400, whilst the former takes its place amongst the wheels of pressure, and has a co-efficient approximating to 0.800, or double that of the other.

In fine, if we may be allowed to make such a comparison, turbines are horizontal *overshot wheels*, and reaction wheels are horizontal *undershots;* both being similar in action and effect to these, except that in consequence of the water acting in both, upon the whole circumference at once, under full pressure, they admit of being made much smaller in diameter than overshot or undershot wheels; on both of which the water of the fall acts efficiently only by a part (sometimes a very small part) of the periphery.

Experiments demonstrating the economical value of Turbine Water Wheels.

The first *turbine* established by M. Fourneyron, after he had completed the plan of his invention, was applied to a saw mill at Pont sur l'Ognon, in France, and a series of experiments were there made by him, to satisfy himself concerning its value as a motor; but although these were perfectly satisfactory, he waited with commendable caution, until he had constructed and put in action several other turbines, (all of which performed well,) before he publicly communicated the results.

Having obtained a patent for his invention in France, he wrote a very able essay which is published in the "Bulletin de la Société D'Encouragement pour l'Industrie Nationale," for 1834, and gives a full description of the invention and of several turbines which he had then constructed; one of them upon a fall of four and a quarter feet, being of fifty horses power. The society above referred to, awarded to M. Fourneyron a prize of 6000 francs for the successful introduction of his wheels into use.

The great advantages possessed by the turbines over other known hydraulic motors, as displayed in their work at various mill seats, soon attracted considerable attention upon the continent of Europe; and in 1837, Capt. Arthur Morin, of the French Artillery, a distinguished experimental philosopher, took up the subject with the view of fixing decisively, the economical value of this motor; and he made a careful, impartial, and prolonged series of experiments upon turbines of large size, which were then driving extensive mills at Müllbach and Mousray, in France.

The record of these trials, with remarks by M. Morin, was published at Metz and Paris in 1838, under the title of "*Experiences sur les Roues Hydrauliques a axe vertical appelées Turbines*," from this work we have derived most of the facts herein embodied, and it will be found well worth an attentive perusal, by persons interested in these subjects.

About the same time also, M. Dieu, a major of Artillery, made experiments upon the useful effect of a turbine, established in the mill of Lepine, which trials were quoted and reduced by M. Morin, in the work above referred to.

Experiments upon the available power of a turbine, were also tried upon one which was established at St. Blaise, in the Black forest, and actuated by a stream of water having the enormous fall of 354 feet!

Finally, connected with a proposition made by M. Arago, to create a small fall in the Seine at Paris, and employ turbines upon it to supply that city with water, in lieu of other contrivances now existing for that purpose; a commission was appointed by the Prefect of the Seine to conduct a series of experiments upon the turbine of Inval, and they particularly examined the effect of backwater upon turbines, arriving, as the others had done before, at the conclusion that the coefficient of useful effect was not sensibly diminished, even when the turbine was deeply immersed in backwater.

As the writer believes that no experience has yet been had in America, with *turbines* at large, he is unable to quote any experiments made here, upon a working scale; but in this case, any further trials than those made upon the continent of Europe, seem quite unnecessary to establish the value of this machine; for those experiments —made by different individuals, at different periods of time, upon turbines of different size, and actuated by different falls of water—corroborate each other so completely as to fix the value of the turbine, as an hydraulic motor, in a manner so definite and conclusive, as to be wholly beyond the reach of cavil or dispute.

The following table contains a very brief summary of some of the results of the numerous experiments above refered to; M. Morin alone having made 48 separate experiments upon the turbine of Moussay, and 84 upon that at Müllbach.

Situation of the Turbine.	Fall of water in feet.	Volume of water used in a second in cubic feet.	Number of turns made by the wheel in a minute.	Useful effect in horses power.	Ratio of the useful effect to the power; or co-efficient of effect.	Name of the Experimenter.
Moussay,	24$\frac{6}{10}$	26	190	45	0.690	M. Morin.
Müllbach,	12	88$\frac{3}{10}$	60	91	0.780	Ditto.
Lepine,	6$\frac{6}{10}$	15$\frac{1}{2}$	75	9$\frac{1}{4}$	0.772	M. Dieu.
Inval,	6$\frac{1}{4}$ to 1	—	—	—	0.770 to 0.650	A Commission.
St. Blaise,	354	1$\frac{1}{10}$	2300	40	0.800 to 0.850	M. Fourneyron.
Pout sur l'Ognon,	4$\frac{1}{2}$	13$\frac{1}{2}$	50	5$\frac{4}{10}$	0.880	Ditto.

Capt. Morin concludes his account of the valuable experiments made by him, with the following.

General Summary of the Experiments on the useful effect of Turbines.

"From all the experiments that have now been made, which relate,

"I. *To the Turbine of Moussay,* where the height of the fall, during the experiments, was about 24$\frac{6}{10}$ feet, and where the wheel was immersed under water about 3$\frac{1}{5}$ feet.

"II. *To the Turbine of Müllbach*, where the height of the fall during the experiments, was about 11½ feet, and where the wheel was immersed under water about 2½ feet.

"III. *To the Turbine of Lepine*, where the height of the fall is about 6½ feet.

"IV. *To the Turbine of Inval*, where the height of the available fall was successively reduced from $3\frac{85}{100}$ to $\frac{96}{100}$ feet, whilst on the contrary, the depth to which the wheel was immersed was augmented from 3¾ to 5¾ feet.

"V. *To the Turbine of St. Blaise*, in the Black Forest, where they used a fall of $354\frac{35}{100}$ feet, with a turbine of $1\frac{80}{100}$ feet diameter, making 2300 turns in a minute, and transmitting a power of 40 horses.

We are able to conclude:

"I. That these wheels are equally suitable to the greatest, as to the smallest falls.

"II. That they transmit a net useful effect, equal to 0.70 or 0.78 of the absolute work, or power, expended by the motor.

"III. That they are able to move at velocities extremely distant, more or less, from that which belongs to the maximum effect, without the net useful effect differing notably from this maximum.

"IV. That they are able to do duty under water at depths from 3¼ to 6½ feet, without the ratio of the useful effect to the power, diminishing notably.

"V. That as a consequence of the preceding property, they use all the time, the whole available fall, since we place them below the level of the lowest waters.

"VI. That they are able to receive very variable quantities of water without the ratio of effect to power diminishing notably.

"If we unite to these valuable mechanical properties of the turbines, the advantage that they offer of occupying but little space, of being able, without great expense, and without embarrassment, to be established in such part of the works as we wish, of moving generally at velocities much superior to those of other wheels, thus avoiding gearing or recourse to the transmission of complicated motions, *we conceive, without doubt, that these wheels ought to rank amongst the best hydraulic motors.*"

The striking property which the turbines have of retaining, unimpaired, their co-efficient of effect, or ratio of effect produced, to power expended, even when deeply immersed in *backwater*, deserves further illustration.

Thus from the experiments made upon the powerful turbine at

Inval, which, actuated by a fall of 6½ feet, drives 400 looms at once; it appears that,

With *a fall* of 3¼ feet, and backwater of 3¼ feet, the co-eff. = 0.77
Ditto. 2 do. do. 4½. do. = 0.72
Ditto. 1 do. do. 5½ do. = 0.65

And M. Fourneyron, in experimenting upon the turbine of Pont sur l'Ognon, found that with the

Wheel *not* immersed —— and with $4\frac{3}{10}$ feet fall, co-eff. = 0.88
Do. submerged $1\frac{64}{100}$ do. $3\frac{4}{10}$ do. = 0.80
Do. do. $0\frac{82}{100}$ do. $3\frac{4}{10}$ do. = 0.87

Other experiments might be cited to the same effect, but that it seems unnecessary to add any thing further in order to establish the important fact, *that backwater does not reduce the co-efficient of effect, appertaining to turbine wheels.*

From the experiments of the French gentlemen, of which the mere results have been already quoted, we may with perfect safety conclude; *that for any fall of water whatever, above a yard high, the co-efficient of the net useful effect, returned by turbines, may safely be assumed at three-fourths of the power expended, whether the site be affected by backwater or not.*

Illustrations of the Utility of Turbine Wheels.

When it is recollected that the first turbine was established at Pont sur l'Ognon, in France, in 1827, that descriptions of several turbines, with authentic accounts of their perfect success, were published in Paris, in 1834, and that the conclusive experiments of M. Morin were made public in 1838, it seems really extraordinary that the turbines have not yet been introduced into, or become known, in the United States; whilst reaction wheels, recommended only by a single one of the good properties of the turbine—that of acting well in backwater—have spread rapidly into every quarter of the Union, although they are very far inferior to the turbine, as an hydraulic motor; and being but little cheaper, must ultimately be superseded by the latter, *in all situations where economy of water is an object.*

That such an advantageous motor, should have been so long neglected by the enterprising people of America, is probably owing, in part, to the fact that the record of those experiments, which have so completely established the utility of the turbine, has been locked up from many in a foreign language.*

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* We must observe, however, that some unsuccessful attempts have been heretofore made in the Journal of the Franklin Institute, as well as in some of the English periodicals, to draw from the public that attention to the turbine wheels which they really deserve—thus in this journal for 1839, some extracts were given from the report of the French Aca-

Be that as it may, no more time ought to be lost in fairly testing the merits of these wheels upon this side of the Atlantic; for that they richly deserve the closest attention of the proprietors of any works impelled by water power, will appear manifest from a very few remarks.

In the first place, *they are cheap, and being made of cast iron are very durable;* and the writer, from some examination into this question, is inclined to the belief, that even in the first instance, turbines are not likely to be much *more costly* than ordinary wheels of the same power, whilst they will certainly be much more durable, *and therefore ultimately cheaper.*

Turbines compared with Reaction, Undershot, and Breast Wheels.

Whilst the co-efficient of effect uniformly belonging to the turbine, under all circumstances, approximates to 0.800; this value in undershot, reaction, and breast wheels, is only about 0.400 for the two former,* and say 0.500 for the latter when unimpeded by backwater; and hence the great advantage possessed by the turbine as a motor, when compared with these, is strikingly evident, *as it amounts to* 100 *per cent. over the two former, and* 50 *per cent. over the breast wheel.*

Thus if at the numerous reaction, and undershot mills, now in active use in the United States, the present wheels were discarded, and turbines substituted, by that simple act, at a comparatively small expense, *the available power of all such mill sites would actually be doubled!* whilst in many mills a good deal of gearing between the motor and the working point might advantageously be dispensed with. To make this more clear, if we assume that any given reaction, or undershot mill is now making 40 barrels of flour per day, then, by the mere substitution of turbines for the existing wheels, *the same mill could man-*

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demy upon M. Morin's experiments; and in 1840 an article on *turbines*, by G. Rennie, Esq., F. R. S., &c., was republished from Herapath's Railway Magazine, London, 1839; notwithstanding this, not much regard seems to have been paid to them, either in this country or in England, up to the present time; but the writer observes, in the late foreign periodicals, that on the presentation of a paper on "Machines recipient of Water Power," by Prof. Gordon, of Glasgow, considerable interest was manifested at a late meeting of the Institute of Civil Engineers, London, and an animated discussion arose, in the course of which, opinions very favourable to the *turbine* were expressed by some distinguished professional men; and hence it is probable that this valuable motor will soon be introduced into England.

* When, in a previous part of this essay, we stated that reaction, flutter, and tub wheels ranked with undershots, and had like them a co-efficient approximating to 0.400; we meant, of course, in case they were working to the best advantage possible; for it is well known to practical men that as they are usually constructed and used, they consume much more water than the best undershot wheels, or have a co-efficient *often much less than* 0 400; indeed the undershot wheels themselves seldom realize, in actual practice, more than one-third of the power expended, whilst the other wheels of impulse are generally still less efficient.

ufacture at least 80 *barrels in the same time, and with the same consumption of water.*

Again, wherever breast wheels are now in use, with a fixed amount of water available, 50 per cent. may be added to the power of such mills by employing the turbine and discarding the others; thus for example, let us take the well known breast wheels at Fairmount, which supply the city of Philadelphia with water by pumping it from the Schuylkill into reservoirs 96 feet high, above the surface of the Fairmount pool.

These wheels require an expenditure of about 30 gallons of water falling eight feet, to elevate one gallon 96 feet into the reservoirs; or estimating friction, &c., at one-fifth, they have a co-efficient of near 0.500; now by substituting for these, the turbine wheels which possess a co-efficient of 0.750, only 20 gallons falling eight feet would be expended in forcing one gallon 96 feet high, into the reservoirs; or with the same amount of water as is now used upon the breast wheels, if the pumps were impelled by turbines, and the friction remained constant, they would force into the reservoirs, 50 *per cent. more water.*

In this calculation we suppose that the turbines work with only eight feet fall, which in consequence of the impediment presented to the breast wheels at every tide by backwater, we have assumed as the average effective fall now used; but as the turbines *disregard backwater,* it would be proper in employing them to lay them lower than the breast wheels are now placed—indeed if it were convenient to follow the rule fixed by M. Fourneyron, in the supposed case of placing Turbines at Fairmount, they should be laid "just below the lowest waters of summer," *or in the plane of the lowest spring tide.*

Then in consequence of the phenomena displayed in tidal rivers, showing that the tide rises *very slowly* upon the last of the flood, and falls *very rapidly* upon the first of the ebb; it would be found that with turbines laid below low water mark, an average effective fall of about four feet, out of the common tide of six feet, could be made available; or as the clear fall to common high water is now six feet at Fairmount, we should in this manner acquire a mean effective fall of four feet more, or ten feet in all, by taking proper advantage of the ability of turbines, *to act successfully in backwater;* it is therefore unfortunate that these water wheels were unknown at the time the mill buildings were erected at Fairmount, as it would scarcely be practicable now, to gain the full fall without injury to them.

Upon these data if we calculate the effect produced at Fairmount, in gallons raised into the reservoirs, for every 30 gallons now used on the breast wheels with eight feet virtual fall; or supposed to be used upon turbines with ten feet effective descent, the following would be the *proximate* results.

With Breast Wheels.	*With Turbines.*
Galls. Ft. fall.	Galls. Ft. fall.
30 × 8 = 240 aggregate power.	30 × 10 = 300 aggregate power.
Power. Co-eff. of effect.	Power. Co-eff. of effect.
240 × 0.500 = 120 useful effect.	300 × 0.750 = 225 useful effect.
Deduct friction of the pumps } 1-5th = 24	Deduct friction of the pumps } 1-5th = 45
Galls. lifted 1 foot = 96	Galls. lifted 1 foot = 180
Then 96 ÷ 96 feet height of reservoir, = 1 gallon raised 96 feet by the *breast wheels*, for every 30 gallons expended with 8 feet virtual fall.	Then 180 ÷ 96 feet height of reservoir, = $1\frac{7}{8}$ gallons raised 96 feet by the *turbines*, for every 30 gallons expended with 10 feet virtual fall.

In fine, if turbines were substituted for breast wheels at Fairmount, and worked with only a little more fall than is now used, they would by the same expenditure of water, *elevate fifty per cent. more.*[*]

But if it were practicable, or convenient, so to locate turbines there, as to avail of 10 feet virtual fall, they would, with the same expense of water, surpass the breast wheels in their work, (though these are well planned and built,) *about eighty-seven per cent.;* and though with the present buildings the necessary arrangements to realize *the full fall* cannot be easily made, still the above calculation demonstrates the vast superiority of this motor for such sites.

As this mode of illustrating the utility of turbines seems to be well suited to the purposes of explanation, the writer will now make a similar reference to the well known water power derived from the Schuylkill river at Manyunk, in this state, and used there upon *overshot wheels.*

Turbines compared with Overshot Wheels.

Although the co-efficient representing the net useful effect capable of being derived from the expenditure of a fixed amount of water, upon overshot and turbine wheels *is identical,* or approximates to 0.800 in both; still the latter are superior as general motors, owing to their ability to use, *or make available, the allowance often made for backwater*, and also to dispense with a great deal of gearing.

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[*] As the day is not far distant when the amount of water required to feed the breast wheels and their pumps, which now supply the city of Philadelphia with water for use, will equal in quantity the entire summer flow of the Schuylkill river—clear of the leakage of Fairmount dam, and of the amount necessary for the navigation—it must be a gratifying reflection to the citizens that when that day does come, all that they have to do is to resort to the use of the beautiful invention of M. Fourneyron, discard all the breast wheels, and substitute turbines in their stead, *whereby their supply of water will be at once augmented at least one half;* and a resort to auxiliary works at Flat Rock, which have been projected in advance by the able and experienced superintendent of the water works, may thus be postponed for another generation, if not entirely relinquished.

Thus at Manyunk, where the head and fall is near 23 feet at ordinary times, it has been deemed advisable, (judiciously without doubt) to throw off, in setting the wheels, *two and a half feet of the fall as an allowance for backwater;* and to employ overshot wheels of but about 17½ feet average diameter, working under three feet head; hence the head and fall actually employed is only 20½ feet; now if turbines were used at that place in lieu of overshot wheels, the backwater might safely be *disregarded*, and thus the entire fall of 23 feet would be made useful, *or about one-eighth would be added to the power of the mills established at Manyunk.*

Advantages similar to those we have recited, have resulted abroad from the employment of turbines in lieu of other wheels, and such a course will be the result here, for it must be particularly remarked that the turbine wheel is not a merely speculative or untried project, *but a thoroughly tested and proved machine, about the utility of which, upon the largest scale which practice requires, not the shadow of a doubt can remain upon the minds of any who choose to investigate the subject.*

The turbine wheels possess another prominent advantage which we will now briefly illustrate; thus upon a 23 feet fall such as that at Manyunk, an overshot wheel of 20 feet in diameter, if running at its best velocity of six feet per second at the skirt, would make but six turns in a minute, whilst a millstone, for example, must run about 120 revolutions in that time; hence, such an overshot wheel, if applied to a flour mill, would require gearing in the ratio of 20 to 1, between the motor and working point; but if the turbine were used in such a place under 23 feet fall, it would, when working at its maximum rate of effect, run at least 175 revolutions in a minute, *requiring no gearing whatever to get up the speed desired;* consequently a considerable saving would ensue from dispensing with the spur gear, whilst at the same time the power consumed in driving this gearing (which is frequently great) would be saved or reserved for direct application to the work.

In conclusion, the chief points of advantage promised by the use of turbines upon the millseats of the United States, may be briefly summed up as follows.

1. They act with perfect success in backwater.
2. They are not liable to obstruction from ice.
3. They require but little gearing to get up a high velocity at the working point.
4. They use to advantage every inch of fall.

5. They are equally applicable to very high and very low falls.
6. They are equal in power to the best overshot wheels.
7. They may vary greatly in velocity without losing power.
8. They are very compact, and occupy but little room.
9. They may be very accurately regulated, to an uniform speed, by means of a governor connected with the annular sluice gate.
10. They are perfectly simple and not likely to get out of order.
11. They are not very expensive.
12. They are very durable.

These, it seems to the writer, are twelve good reasons, for the adoption of turbines as the motors in all future mills erected in this country —indeed they would fully justify the substitution of them in place of most of the wheels now in use upon our mill seats; for either upon one account or another, the turbine is superior to all other water wheels, *and consequently must be regarded as the very best hydraulic motor now known to mechanics.*

Philadelphia, Sept. 1, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cost of Transportation on Railroads. *By* C. Ellet, Jr., C. E.

[CONTINUED FROM PAGE 233.]

On the Relative Values of Distances and Gradients.

In the preceding numbers I have offered convenient and appropriate formulas for computing the cost of transportation on railroads, and determining the effect produced on that cost by variations in the acclivity of the limiting gradients. I propose now to ascertain the value of any increase or diminution of the length of the line in terms of that grade; that is to say, to determine how many feet per mile the steepness of the limiting gradient may be increased for the purpose of saving one mile of distance; or what increase of distance will be justifiable in the development of a road for the purpose of reducing the line to a level, or of saving any given amount in the rate of ascent of the limiting gradient.

For this purpose we will recur to our formula (B), which expresses the annual charges of the company, and write it thus—

$$\left(2\,\mathrm{C}\,\frac{20 + x'}{20\,\mathrm{W}}\,t' + c\,t'' + \frac{14\,t}{1000} + 500\right)h;$$

in which x' is put for the empirical, or accidental grade, in feet per mile, which it is desirable to relieve; t' the number of tons gross which annually ascend that grade in full trains; t the number of tons net annually transported through the line, in both directions and in full trains; t'' the number of tons gross carried through the line; C the cost of running a freight engine with its tender one mile; c the additional cost of locomotive power for each gross ton carried one mile, and h the length of the road in miles.

It will, of course, be observed that this formula is applicable only to roads which are used exclusively for the conveyance of freight, and is obtained in the supposition that all the engines are loaded to their maximum capacity on the limiting gradient. But in all lines used for general travel, the passenger trains, at least, and sometimes a portion of the freight trains, are much lighter than the engine is capable of conveying on this grade.

In order, therefore, to express correctly the aggregate annual expenses, *on such lines*, and to render the equation, which it is proposed to deduce, as general as possible, we must add to the above formula the cost of motive power for the number of miles traveled by the engines which are not fully loaded, and the expenses incident to the conveyance of the whole number of through passengers, which are not covered by the cost of power. These expenses have already been stated to be $\frac{p\,h}{100}$, where p represents the number of passengers carried "through;" and if we represent by N′ the number of trips made by engines carrying passengers and less than their full compliment of freight, and by C′ the cost of running such engines with their tenders one mile, the expression of the aggregate annual expenses, in its most general form, will become

$$\left(C'\,N' + 2\,C\,\frac{20 + x'}{20\ W}\,t' + c\,t'' + \frac{14\,t}{1000} + \frac{p}{100} + 500\right)h; \quad (G)$$

in which only one of the terms is affected by the value of the grade.

This is a modification of the approximate formula (A), given in a previous number, and is expressed in different terms, though it yields very similar results.

By means of this expression we may readily compare the merits of two lines, of different lengths and grades, and accommodating the same, or different amounts of tonnage, and determine the difference between their values. For this purpose we have only to substitute for the notation the actual values of the gradients, and the lengths of the two lines, and calculate by the equation the annual charges which they respectively involve.

It was from this expression in the simpler state in which it may be presented for application to a road on which the business is restricted exclusively to the transportation of freight, that we determined, in the preceding number, the sum which might, with propriety, be expended for the reduction of the limiting gradient. But we are not to regard that expression as authorizing a diminution of the acclivity of the gradient, at the expense of any augmentation of distance, unless the value of the increase of the distance be taken into the account. Any increase of the length of the line of the improvement necessarily involves an increase of expense for its maintenance; for the locomotive power which traverses it, and for the cars which pass over the additional distance. The value of this increase of the annual charges consequent on any augmentation $h'-h$ is obviously

$$\left(C' N' + 2\,C\frac{20 + x'}{20\,W}\,t' + c\,t'' + \frac{14\,t}{1000} + \frac{p}{100} + 500\right)(h'-h); \qquad \text{(H)}$$

an expression from which we are able to calculate immediately the annual value of any augmentation or reduction of the length of the road, and consequently the sum which it would be expedient to expend for the purpose of effecting any given reduction.

But we have already seen that if we diminish the inclination of the maximum gradient any quantity $x'-x$ feet per mile, we simultaneously reduce the aggregate annual expenses the amount represented by the expression

$$2\,C\frac{x' - x}{20\,W}\,t'\,h.$$

In order, then, to determine the change in the length of the line which will have the same effect on the cost of transportation as any given reduction of the limiting gradient, we must equate these two quantities, and deduce from the equation the value of distance, or $h'-h$ in terms of the change of gradient. This operation produces for the expression of the quantity which we will be authorized to increase the length of a road for the purpose of reducing the limiting gradient, of which the ascent is x' feet per mile, down to any other rate x feet per mile,

$$\frac{C}{10\,W}\cdot\frac{h\,t'\,(x' - x)}{C' N' + 2\,C\frac{20 + x'}{20\,W}\,t' + c\,t'' + \frac{14\,t}{1000} + \frac{p}{100} + 500} = h'-h. \quad \text{(I)}$$

The augmentation of the length of the road adequate to compensate for any given reduction of the limiting grade, is therefore directly proportional to the original length, and reciprocally, or very nearly so, as the power of the engines used in the conveyance of the freight. The greater the tonnage which ascends the limiting gradient, the greater is the distance that the length of the line may be increased in order to reduce that gradient any given amount per mile; and the greater the power of the engine kept in operation at a given expense per mile run, the less would be the increase of the length of the road for the same purpose. The greater the number of passengers that are carried in light trains, and the greater the proportion of the tonnage which is conveyed by engines loaded below the maximum due to the limiting grade, the shorter must be the line and the steeper the grades. The measure of all these influences is deducible from the formula, which I regard as the true equation of distance. It is expressed in as accurate terms as it is practicable to obtain with our present experience. In course of time the co-efficients may, perhaps, be advantageously modified, to suit the more precise determination of the value of railway constants, which we may anticipate from the increasing facilities which are offered, and the more accurate observations which such facilities will permit.

In order to apply the formulas, we must determine the values of C, C′ and c. Of the two first, C may be estimated, in ordinary cases, at three-tenths of a dollar, and C′ at a quarter of a dollar; and experiment will justify the assumption of a half mill per mile for the average increase of the cost of motive power, due to each gross ton added to the load of the engine—a fact which is expressed by the equation $c = \frac{1}{2000}$ of a dollar. In the formula t'' is put for the gross tonnage of the line, consisting of passengers and freight and the cars which contain both, whether attached to engines conveying full or partial loads.

Let us take the following case for an example. The length of the road, by the preliminary survey, is 30 miles; the limit grade which the eye and judgment have established on the profile, is 40 feet per mile; the anticipated freight is 60,000 tons net, and is likely to be so divided in direction that there will be found an annual gross weight of 40,000 tons ascending this limit grade. The tonnage trains are supposed to be full, and the gross weight of cars, freight and passengers is 130,000 tons. The number of through passengers is 20,000, and the power of the engines intended to be used is adequate to the command of 300 tons gross on a level road. Now,

I. How much would it be good policy to expend in the construction of this road in order to reduce the grade which limits the load from 40 feet down to 30 feet per mile?

II. How much could we afford to pay for the reduction of the length of the road one mile?

III. How much would we be authorized to increase the length of the road in order to reduce the rate of ascent of the limit grade ten feet per mile?

IV. How much would we be authorized to increase the length of the same road in order to reduce the limit grade ten feet per mile, in the supposition that no passengers are to be conveyed, and that the gross tonnage is all conveyed in full trains, and amounts, exclusive of passengers and their baggage, to 120,000 tons?

Now we have $C' = \frac{1}{4}$; $C = \frac{3}{10}$; $c = \frac{1}{2000}$; $t = 60{,}000$; $t' = 40{,}000$; $t'' = 130{,}000$, and for the fourth problem 120,000; $p = 20{,}000$; $h = 30$; $x' = 40$; $x = 30$, and $W = 300$.

The appropriate quantities being substituted in equation (F) will give, in answer to the first problem,

$$\frac{40{,}000 \times 30 \times (40 - 30)}{600} = \$\,20{,}000:$$

or, it would be worth while to expend 20,000 dollars in grading the road to reduce the ascent of this limiting slope ten feet per mile, providing we do not thereby incur any increase of the cost of maintenance, or any augmentation of distance.

Again, by inserting the values provided by our data in equation (H) we obtain, for the solution of the second problem, in the supposition that the passenger trains make two trips a day, or that $N' = 730$

$$\frac{730}{4} + \frac{3}{5} \cdot \frac{20 + 40}{20 \times 300} \times 40{,}000 + \frac{130{,}000}{2{,}000} + \frac{14 \times 60{,}000}{1{,}000} + \frac{20{,}000}{100} + 500 =$$

2,027 dollars, for the annual charge incident to each mile of the length of this particular road. We multiply this quantity by $\frac{100}{6}$ to obtain the equivalent capital, which we find to be \$ 33,783.

It would be worth about \$ 34,000 to reduce the length of this road one mile.

Again, by inserting these values in equation (I) we will obtain in solution of the third problem

$$\frac{\frac{3}{10} \times 30 \times 40{,}000\,(40 - 30)}{3000\left(\frac{730}{4} + \frac{3}{5} \cdot \frac{20 + 40}{20 \times 300} \times 40{,}000 + \frac{130{,}000}{2{,}000} + \frac{14 \times 60{,}000}{1{,}000} + \frac{20{,}000}{100} + 500\right)} = \frac{1200}{2027}$$

or about *four-sevenths of a mile.* On such a road, the value of ten feet in the limiting grade is only equal to four-sevenths of a mile in distance, although that grade is not opposed to the heavy trade—a fact which should prompt us to be on our guard when we attempt to reduce the grades of a road by an increase of distance before we have examined well into the character and amount of the trade which is to be accommodated.

Finally, we shall have, for the solution of the fourth problem,

$$\frac{\frac{3}{10} \times 30 \times 40{,}000\ (40 - 30)}{3000\left(\frac{3}{5}\ \frac{20+40}{20 \times 300} \times 40{,}000 + \frac{120{,}000}{2{,}000} + \frac{14 \times 60{,}000}{1{,}000} + 500\right)} = \frac{40}{55}$$

or about *five-sevenths of a mile:*—showing that we can increase the length of this road 25 per cent. more, for the purpose of reducing the grade any given amount when we carry no passengers, although the amount of freight is the same, than when the road is destined, in part, for the accommodation of travel. This is simply to say that the value of distance increases with the increase of every part of the business of the line; while the value of a gradient increases only with that portion of the business which ascends it in full trains.

It may be objected to the method which is here pursued that the calculations are predicated on data which are exceedingly difficult, if not impossible, to procure, in anticipation of the experimental result. It is certainly true that such inquiries are not free from some difficulty and uncertainty; and it is also true that the engineer must overcome this difficulty or proceed to his work entirely at random. The values of grades and distances turn upon these facts, and they must either be regulated without regard to any principle, or by these, or some similar equations. The application of the equations will, of course, be somewhat inconvenient, since they compel us to know something about the thing we are doing; they compel us, when we propose to cut down a hill or fill up a hollow, to know what it is to be done for, and to judge how much we shall cut, and when we shall stop. But, however inconvenient it may be to answer such inquiries, it is not the less important to study the subject, and learn how to answer them by some better mode than mere conjecture.

It is unnecessary to make additional application of the formulæ. They are remarkably simple and obvious, and by supplying a ready and convenient mode of comparing different lines, or different locations of the same line, they remove many of the difficulties with which every engineer must have felt himself embarrassed in the exploration or establishment of important improvements. They indicate the proper and only convenient general mode of estimating the aggregate cost of transportation under different assumed quantities of tonnage; and teach us, in the location of a line, the correct value of distance—in the calculation of which the cost of freight is the essential element—and at the same time enable us so to regulate the grades that the transportation may not be improperly embarrassed, and that the company may not be induced to pay more for the reduction of the cost of freight than the reduction is worth. These are all matters of great interest, and questions which can never be overlooked by an engineer who faithfully performs his duty. Indeed, they must all be met, and maturely considered, at every step of his progress, or the work which is placed under his professional charge will be found to be a failure, and in all probability soon pass into the hands of assignees, or come under the hammer of the Sheriff. They are always objects of immense consequence in the decision of the great questions of general location, which arise in determining the proper routes for railroads of great extent, passing through districts where different lines, having various pretentions, are presented, and where the comparisons of distances, grades, and elevations are of constant occurrence. They are also important where no such general choice is presented, in determining on the details of the location of every line. A road is scarcely ever surveyed on which there is not found some one gradient which controls the average load of the engine, and which it is desirable to reduce.

The first point to be determined, in all such cases, is the probable amount of trade to be transported. This is the leading fact which should govern all the arrangements which are to be made with a view to its accommodation; and the one which has probably elicited the least attention of all in the construction of the railroads, great or small, of this country. There are some lines which were apparently intended for the accommodation of immense quantities of freight, in the design for which no computation was ever instituted for the purpose of ascertaining the probable amount of the trade, or the sum which that quantity would authorize the company to expend for the purpose of removing given obstructions; and there are others on which the actual tonnage is so small that the directors have yet been ashamed to name it to the public, although, in the construction of their road, they permitted arrangements to be made for its accommodation, on a scale of magnificence which could hardly have been justified in anticipation of the trade of India. More labour has been expended in the transportation of materials for the construction of many roads than would have been required to effect the transportation without them of all the tonnage which they are destined to transmit, for all time to come.

There is, accordingly, no return received for the absorbed capital; these works are failures, and they have failed in consequence of the disrespect of the parties by whom they were destroyed, of the first principles which should control every application of machinery to economical purposes—viz. *to make the power proportional to the duty to be performed—and to expend no more money for any object than the value of the object will warrant.* Had this simple maxim been kept constantly in view in the prosecution of the enterprises which, in this country, have characterized the last twelve years—and been made the test of every plan and every arrangement—there would have been no ruined companies, no railroad auctions, and probably no failures.

In discussing the important questions incident to this subject, the object has been to obtain fair average values of the points at issue, and to deliver the results of the investigation as free from algebraical expressions as is consistent with the necessary accuracy. In this view several quantities, of subordinate consequence, have been overlooked, and the investigation is made to turn upon the essential considerations which rule the result. And this is sufficient; for it is in vain to hope for the attainment of perfect accuracy in questions of this nature, where much uncertainty always prevails in the determination of the value of the data; and the solution which comes within 10 or 15 per cent. of the truth possesses all the accuracy that is necessary to insure the requisite confidence. It is not to *such* errors that companies may trace their destruction; but to the utter and entire disregard of all the essential quantities, circumstances, and considerations, on which success was dependent.

The ruling fact, which ought to control every movement and every plan, is the number of tons to be conveyed one mile. This quantity is made up of the absolute tonnage and the length of the line. If a locomotive engine of 50 horses power be capable of conveying the daily trade on a road 50 miles long, it follows that an engine of five horses power will be adequate to the conveyance of the same tonnage on a road five miles long. And if an engine of 50, or any other number of horses power is able to accomplish the whole labour required on the first road, the same engine will be occupied but *one hour out of ten* in doing the work of the second road. The shorter road, therefore, requires less power—engines of less weight—rails consequently of less strength—and admits, as we have seen, of steeper grades.

In short, *the number of tons to be carried, and the distance which it is to be carried, control the grades, establish the location, and determine the power; the power required fixes the weight of the engine which supplies it; the weight of the engine rules the strength of the rail by which it is supported, and the strength of the rail limits the weight of the car and its load.*

There are certain obvious relations between the duty to be performed by the road and the capacity of the improvement, and the power of the machinery to be applied on it; and if these relations be not respected, both in the general design, and in all the detail, it can only be by sheer accident that the enterprise is successful.

[TO BE CONTINUED.]

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Memoir Descriptive of the Explosion of the Boiler of the Steamboat Medora, in the port of Baltimore, in 1842; *embodying all the leading facts which could be collected on the spot, and accompanied by some suggestions concerning the general construction and management of Steam Boilers. By* BENJAMIN H. LATROBE, Civil Engineer.

TO THE COMMITTEE ON PUBLICATION:

Gentlemen,—I regret that several causes have concurred to make the memoir of the explosion of the "Medora," requested of me in your letter of April 27th, and promised by me through my friend Mr. E. Morris, so late in its forthcoming, especially as I find that it must be, after all, but a brief sketch of the disaster. I have been unable to gather much other testimony than that which has appeared in the papers; most of which is but little to be relied on, coming, as it did, from witnesses either interested in disguising the truth, or incapacitated by the awful circumstances of the accident, from correct observations, or relation of the facts. The history of the occurrence is shortly as follows.

Upon the 14th of April, 1842, the Medora, a new steamboat, built by a company, to run between Baltimore and Norfolk, was prepared for a trial trip down the Patapsco. She lay at the engine builder's (John Watchman) wharf, on the south side of the Basin. Her fire was lighted at about 2 o'clock P. M., and about an hour after, the agent and some of the proprietors came on board, and she prepared to start. There were probably between 50 and 100 persons in her when she started, many of whom were workmen connected with her construction, and, as on such occasions, these persons, each deeming himself to be "magna pars" of the affair, are prone to intermeddle; there was much crowding and confusion about the engine, and its proper management by the engineman was not unlikely to be interfered with. The pride of the workmen in the expected performance of the boat would naturally dispose them to do all they could to accelerate her speed, and the suspicion afterwards expressed, that undue means were employed to increase the pressure of the steam, was not unreasonable. It has also, indeed, been supported by sufficient testimony; though at the same time contradicted, I am told, by one of the surviving witnesses of the calamity.

The boat had just cast off her lines, and in backing out, had made one or two revolutions of her wheels, when her boiler burst. Five and twenty persons on board, were killed or mortally wounded; the upper, or promenade, deck over the boiler, was blown in fragments into the air, and the forward part of the hull so shattered that she immediately sunk in ten or twelve feet water. Her engine, except in its connexion with the boiler, and the after part of the hull, was uninjured. The accompanying drawings, by their dotted lines and shaded parts, exhibit the form and position of the boiler before and after the explosion. It was placed forward of the wheel houses, standing fore and aft, in the hold of the vessel, and rising up through the main to within three or four feet of the upper deck. The boiler was thrown upwards to the height of the top of the engine beam, or more than thirty feet, and, while in the air, it turned, so as to fall upon its side, exactly crosswise of the boat. Circumstances connected with the escape of the steam and water, and the resistance of the wood work of the upper deck, no doubt caused this singular rotation.

The boiler, (see figs. 1 to 5, Plate I,) consists of a cylinder eleven feet in diameter, and nineteen feet long, supported on three legs, A, B, C, of the same horizontal length, and composed of sheets five and a quarter inches apart, connected, as usual, by staybolts. The side legs, A and C, are about seven feet, and the middle leg, B, two and a half feet high. To admit the water into these legs, the cylinder, or belly, of the boiler is cut away by rectangular apertures at frequent intervals. The lower half of the cylinder is occupied by forty-seven tubes, eight inches in diameter, through which the smoke and flame are returned forwards, from the chamber at the back of the boiler, towards the chimney in front. Between and above the rows of tubes, were round tie rods three-fourths of an inch diameter; horizontal and crosswise to the cylinder, but similar rods could not be introduced vertically between the tubes on account of the spaces between them not coming in a line over each other. Thus the top and bottom of the cylinder were not stayed by direct ties connecting them in the position of chords—but the top angles at either end of the boiler were braced by diagonal bars and rods, as shown by fig. 5, and above the tubes were one or two rows of longitudinal rods of one inch diameter, going from the forward to the after head. The sheets of the boiler were of the *usual* thickness of one-quarter of an inch, and do not appear to have been of bad quality. There were two fire doors in front, for the introduction of the fuel into the spaces between the legs, see fig. 4; and in the sheet iron composing the front of the smoke chamber supporting the chimney stack, there was a small, movable, circular door opposite each tube, for the insertion of an instrument to clean the flues, when required. The number of gauge cocks was *four*, the lowest being a little above the level of the highest row of tubes. The safety valve was placed upon a drum near the top of the boiler, and was, as will be seen hereafter, of large dimensions.

Such was the boiler in all its parts; and its unusual size and bold design, must be striking to every observer.

An examination of the wreck of the boiler, as it still stands in the yard of Mr. Chas. Reeder, engine builder, and as it is correctly exhibited in the several views presented in the drawings, clearly shows that it first gave way where the legs unite with the belly, and where the removal of so much of the metal reduced the strength of the cylinder to its minimum. The explosion was *downwards,* carrying away the right hand or starboard leg, and the middle one (see figs. 3 and 4,) and tearing into shreads the inner sheet of the larboard leg, (see fig. 5,) at its junction with the cylinder. The escape of the steam and water, principally on the starboard side, probably caused that side to revolve vertically in the rise of the boiler into the air, and thus would have made it fall upon its larboard side in the descent, while at the same time a horizontal revolution was effected by the forward rush of the expelled fluid towards the angle made by the front and starboard side, this part of the front appearing to be pushed outwards. The boiler evidently fell first upon the hind and upper larboard corner, which is seen to be much crushed, while the explosion operated most powerfully on the front and lower starboard corner. These two corners are diagonally opposite to each other, and this circumstance may account (in connection with the entanglement of the boiler in the fragments of the upper deck,) for the rotation. As the boiler lay in the hold on its larboard side after the explosion, the starboard and middle legs, together with the portions of the cylinder between them, were not entirely detached, but were so far bent backwards, and curled over, as to embrace the circular top, and previous to the raising of the boiler out of the sunken hull of the vessel, they had to be separated by the chisel along the ragged lines *f*, *g*, (fig. 3.) The cutting of the apertures over the legs, in the manufacture of the boiler, to admit the water into them, left the segments of the cylinder, between the legs, united only by the strips of sheet metal remaining, and of these strips, as seen in figs. 3 and 5, not more than one half the original number are left, the rest being carried away by the explosion. The other injuries received were partly due to the rupture and partly to the fall of the boiler, and the numerous and extensive rents manifest the insufficiency of the opening first made, though large, to vent the confined fluid, and that the destruction once begun proceeds, ad libitum, as in almost all similar cases.

Description of the Drawings, which exhibit various views of the Boiler of the Medora after its explosion.

The drawings from 1 to 5, inclusive, are by a scale of four feet to the inch.

Fig. 1 is a view of the *larboard side* of the boiler.

a, the *four* gauge cocks.

b and *c*, rents in the side of the boiler, where the rivets are torn out.

d, d, d, other rents.

e, place of the safety valve.

f, corner upon which the boiler pitched after being projected in the air by the explosion; and within the crumplings of the iron at this corner, a piece of timber, torn from the deck, was still inclosed, when this drawing was made.

Fig. 2 is a view of the *back* of the boiler.

a, the man hole.

b, b, b, holes left by fragments blown out in the explosion.

Fig. 3 is a view of the *starboard side* of the boiler.

a, a, holes cut by a chisel.

Fig. 4 is a view of the *front* of the boiler.

d, d, the fire doors for the admission of fuel.

The 13 tube holes shaded darkest have their tubes still in them, the remaining tubes have been removed since the explosion, but were uninjured by it.

Fig. 5 is a *vertical section* through the length of the boiler; the dotted lines, in this and fig. 2, showing the original outline of the boiler, the water legs, &c.

a, the back smoke box.

b, the front ditto.

Fig. 6 is a *general sectional view*, showing the position of *the boiler* and of the chief parts of the machinery. Drawn by a scale of 30 feet to the inch.

The construction of the boiler, and the manner of its destruction, having been thus described, I proceed to estimate its strength from the data I have procured, together, and in comparison, with the probable pressure of the steam at or near the time of the explosion, and to state the facts of which I received information, respecting some of the circumstances of the accident, accompanied by such remarks as have suggested themselves to me in regard to its causes and effects.

The weakest part of the boiler, to which the calculation must evidently be applied, was manifestly the part of the cylinder immediately over the legs, where the continuity of the sheets was interrupted by the apertures made in them to let the water down into the legs and promote its circulation throughout the vessel. One half of the strips of iron left between these apertures has been carried away, and the measured width of those that remained is irregular; but there is enough to show that the united breadth of all the strips did not exceed that of the spaces between them, so that the boiler was not more than half as strong over the legs as elsewhere, ceteris paribus. Thus in every twelve inches of the length of the cylinder there were but six inches of sheet iron to unite the segments separated by the legs. A further reduction of strength in the connection of these segments was again made by the occurrence of seams in the strips, depending on rivets, and weakened by the holes punched for their insertion. Now the strength of a joint of this kind will depend upon the resistance of the rivets, and also on that of the remaining iron of the plates which they unite; which resistances should manifestly balance each other, to give the maximum of strength to the joint. The plates may be separated in three ways. 1st, by cutting off, or tearing asunder the rivets, or tearing off their heads. 2nd, by splitting and tearing out the metal between the rivet holes and the edge of the sheet. 3rd, by tearing off the sheet iron between the holes, and in a line with their centres. That it may be indifferent, so far as dimensions are concerned, in which of these three ways the joint may separate, there must be certain fixed proportions between the diameter of the rivet, (the head of which we will suppose to have always such an excess of strength as to make the shank of it give way first,) the clear distance between the rivet holes and the edge of the plate, and the clear distance between the holes themselves, the thickness of the sheet being of course a constant element. Let us now see whether, in the riveting of the sheets of this boiler, the correct proportions were observed—1st, the rivets are eleven-sixteenths of an inch in diameter, and each has a transverse sectional area of 0.375 of a square inch, and, there being three rivets to every *strip* of six inches wide, the whole area of the rivets will be 1.125 square inches. 2nd, the line of metal left between the holes will be $(6 - 2.062) = 3.938$ inches wide, which multiplied by one-fourth of an inch, (the thickness of the sheet,) will give an area of 0.985 of a square inch. 3rd, the clear distance of the holes from the edge of the sheet, is one and a quarter inch, which, multiplied by one-fourth of an inch, gives an area of 0.312 of a square inch and for the three holes a total area of 0.936 of a square inch. The three resistances appear thus to be somewhat unequal, that of the rivets being the greatest by 14 per cent. of the strength of the metal between the holes, and 20 per cent. of that of the metal between the holes and the edge of the sheet. But when it is recollected that in the first case

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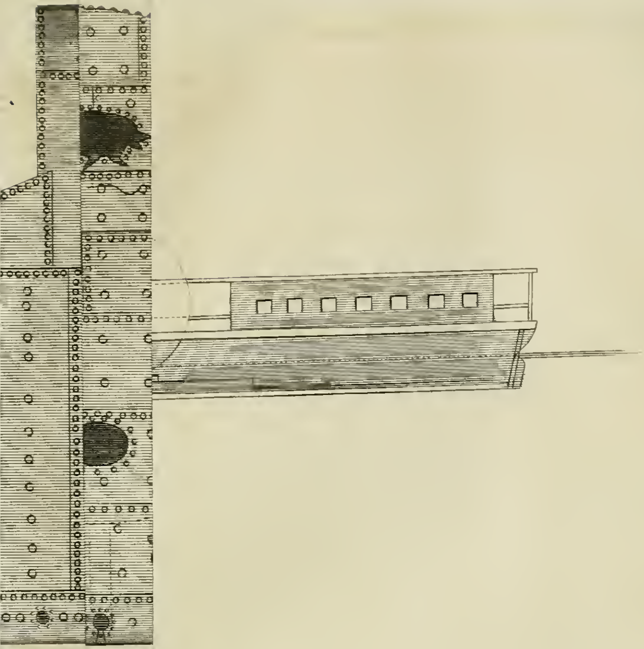

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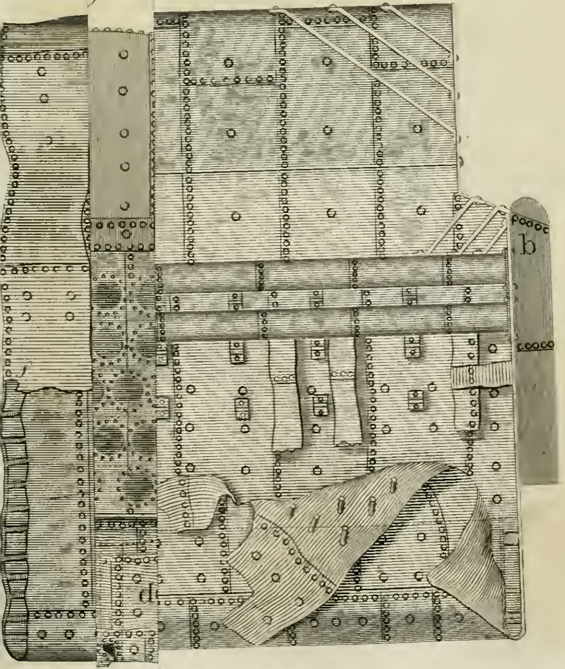

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Fig 1

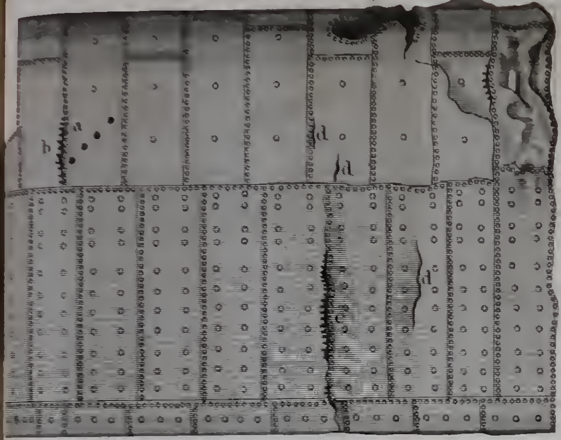


Fig 2

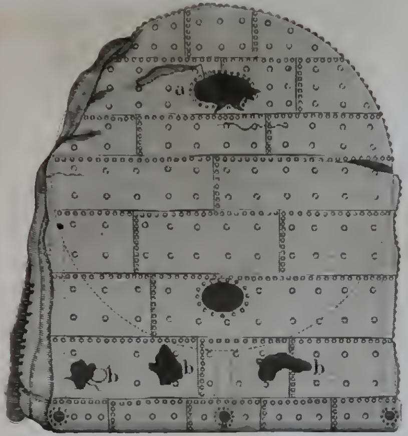


Fig 6

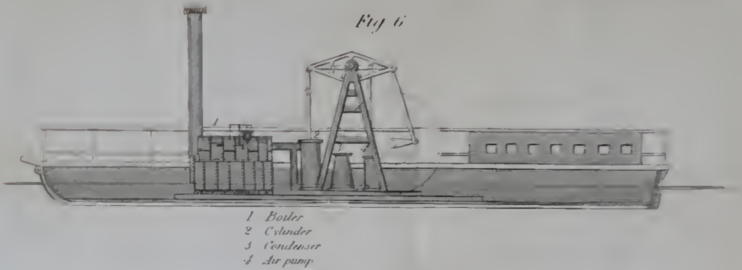


Fig 3

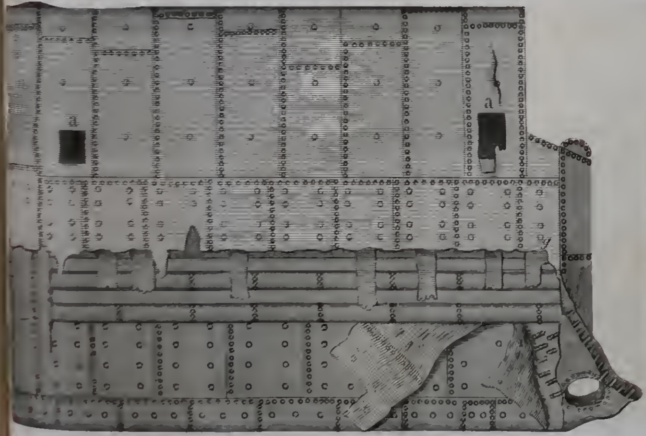


Fig 4

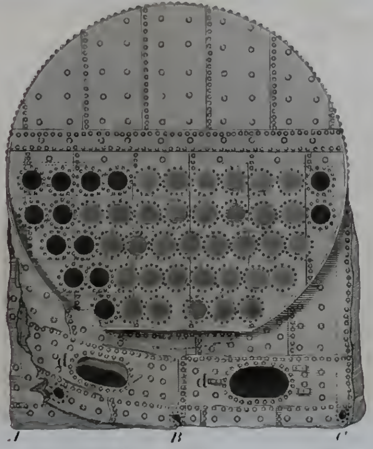
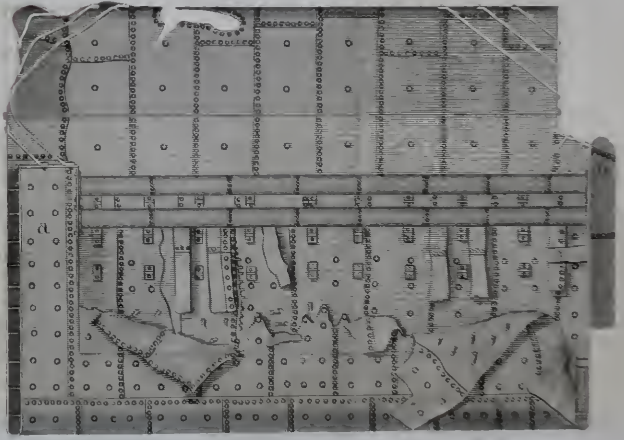


Fig 5



the rivet loses part of its whole strength by the strain it suffers in cooling, after being headed in a heated state, and that in the third case the tearing out of the metal involves more than the mere separation of the area of resistance, inasmuch as to permit this, the metal must be considerably bent on either side of the line of rupture through which the rivet makes its way out, and as furthermore, the *friction* of the lapping surfaces of the plates augments their opposition to a separation by sliding on each other, it would seem as if the three resistances were very near to a practical equality, and that the sizes, numbers, and positions of the rivet holes were about what they should be, for the required equilibrium between the parts of the joint. Other boilers which I have examined show a similar adjustment of parts in the joints, so that general practice would seem to accord with the conclusions of the present calculations. An inspection of the manner in which the plates of the Medora's boiler separated at the seams, showed that, in most instances, the metal between the rivet holes and the edge of the sheets, gave way by tearing out, leaving the rivets and intermediate metal uninjured, and this consists with the preceding estimate which makes this element of the joint the weakest of the three. Inasmuch, however, as they approach so nearly an equality of strength, and each may occasionally give way before the others, it may be as well to take the *average* of their resistances for an expression of the strength of the joint, and this should be $\frac{1.125 \times 0.925 + 0.936}{3} =$ 1.015, or say one square inch of metal for every twelve inches (six inches of strip and six inches of space) in the length of the boiler, one-twelfth of a square inch, per running inch of the same; and this is the measure of the strength of that part of it over the legs. Now the elements of the calculation to determine the strain that a cylindrical vessel will bear, from the outward pressure of an elastic fluid, consists of the diameter of the cylinder, the thickness of the material composing it, and the modulus of the strength of that material. Thus if D be the diameter of the cylinder, t the thickness of the iron (both in inches,) P the average force in pounds that will tear asunder a square inch of boiler iron, and x the steam pressure per square inch on the boiler sufficient to burst it, we have the equation $D\,x = 2\,P\,t$, where $x = \frac{2\,P\,t}{D}$. Now $D = 132$ inches—$P = 55{,}000$ lbs. $t = \frac{1}{4}$ of an inch. Consequently $x = 208\frac{1}{3}$ lbs. which would be the pressure of the steam per square inch required to burst the boiler, if it were a continuous hollow cylinder without seams or joints to reduce the quantity and resistance of the metal composing it. But this is not the case in any boiler. The joinings if the plates, if there were no holes in the boiler, would necessarily reduce the strength to about two-thirds of the entire strength of the sheets, were it not for the support they yield each other at the *laps*, where they are doubled upon each other. In the Medora's boiler, it is seen above, that for every twelve inches in the length of the cylinder over each leg, there is but one square inch of metal resisting rupture, instead of three square inches, which there would be if there were no rivet holes, or spaces, between the strips of iron. So the strength of the boiler over the legs is reduced to the one-third of its full strength in other places, where there are no seams, or perforations; consequently, we must divide the value of x, as above obtained, by 3, to get the real pressure, per square inch, that the boiler was capable of sustaining. Then $\frac{208-33}{3} = 69.44$ pounds per square inch, the utmost strain that this boiler could have borne, without giving way at this, the weakest place. The pressure here spoken of, is of course the *effective* pressure, or the excess of that of the steam over that of the atmosphere.

Let us now proceed to estimate the pressure which could have been produced upon the boiler of the Medora by loading the safety valve to the utmost with the weights which were *attached* to it, and intended so to be used, when occasion should require the maximum pressure, considered by the engine builder to be safe. The diameter of the valve was $15\frac{1}{4}$ inches at the bottom, with a mitre of $1\frac{3}{4}$ inches, making its top diameter 17 inches. The levers of the valve were of the second order, and two in number. The primary lever, operating immediately on the valve, had a total length of 35 inches, and from the fulcrum to the centre of the valve disk, was $12\frac{1}{2}$ inches, making a ratio of $\frac{1}{2.8}$. The secondary lever, operating on the end of the primary one, had a total length of 67 inches, and from the rod connecting the two, to the fulcrum of the former, the distance was 10 inches. There were two weights, of cast iron, on the secondary lever, the largest, nearest to the end of it, weighing (by estimate) 200 pounds, and the smaller 56 pounds. When these two weights, which slid as usual on the arm of the lever, which they were perforated to receive, were in contact, and pushed out to the end of the lever, the distance of their centre of gravity from the fulcrum of the long lever, would be $57\frac{6}{10}$ inches; so that the ratio of this lever would be $\frac{1}{5.76}$ and the ratio compounded of those of the two levers $\frac{1}{5.76} \times \frac{1}{2.8} = \frac{1}{16.128}$. If the area of the valve be calculated, from its mean diameter,—viz: $\frac{15.25+17}{2} = 16\frac{1}{8}$, it will be found $= 204\frac{2}{10}$ square inches. Then the extreme pressure which the attached weights could produce upon the safety valve would be equivalent to 256 lbs. $\times 16.128 = 4128\frac{77}{100}$ lbs., or, per square inch of the valve $= 20\frac{22}{100}$. This is exclusive of what is due to the weight of the valve, and its rod and lever, which may be estimated as follows: for the valve itself, without leverage, 100 lbs.; for the short, or primary, lever, 20 lbs. $\times \frac{17.5}{12.5}$ (the leverage of its centre of gravity) = 28 lbs.; for the connecting rod 10 lbs. $\times \frac{35}{12.5} = 28$ lbs.; for the long, or secondary, lever, $56\frac{1}{2}$ lbs. $\times \frac{35}{12.5} \times \frac{33.5}{10} = 536$ lbs, being in all 692 lbs. *at the seat of the valve:* and this will increase the whole pressure there to $4820\frac{77}{100}$ lbs., or to $23\frac{6}{10}$ lbs. per square inch of the valve and boiler.

This appears to be the highest pressure which could be brought upon the boiler by the system of weights and levers belonging properly to the valve.

The strength of the boiler, in its weakest places, being then estimated, as above, at $69\frac{44}{100}$ lbs. per square inch, amounted to just three times the extreme pressure which the engine builder appears to have intended it should be called on to bear, and in proportioning the strength of his work to the duty it was to perform, he would seem to have been sufficiently prudent. How, then, did the boiler explode, when guarded by a safety valve of such ample dimensions, designed to give way at one-third of the bursting strain?

That the free action of the valve must have been interfered with, would be a natural conclusion, and is corroborated by the testimony of one of the assistant enginemen, as will be presently mentioned. That the valve had been before loaded to produce a pressure greater than the limit prescribed by its own construction, may be inferred, indeed, from the statement of Mr. Watchman himself, who says, in his examination before the *Coroner's Inquest,* that the evening before the accident, the boiler was tried, and the valve raised with 27 inches of steam, or 27 lbs. per square inch, *as he had calculated,* and that on the previous Saturday, also, the boiler had been tried, and 31 lbs. per sq. inch put on. The lowest of these pressures being $3\frac{4}{10}$ lbs. per square inch beyond the above estimated extreme of $23\frac{6}{10}$ lbs., auxiliary means must have been employed to increase the steam pressure on the trials referred to, but as Mr. Watchman is silent on this point, and also as to the mode in which he arrived at the pressure, whether from an inspection of the mercurial gauge, or a calculation of the proportions, &c., of the valve, it cannot be known whether his calculation conflicts with the one I have offered. He says, furthermore, that about half an hour before the explosion, he observed the gauge to show 10 inches of steam, and that he then tried to lift the safety valve, *but could not;* and after examining the rope attached to the valve lever, to see if it was on the pulley, he walked away. The result of this examination of the rope he does not state, but he seems to have had fears that some improper means of keeping down the safety valve had been used. That he should not have taken more pains to verify these fears, may well excite surprise. A very short time before the explosion, he says he was told by the acting engineman that the gauge showed 22 lbs. per inch of steam. Another witness says that when the weights were pushed out by him on the long lever, as far as they would go, the steam pressure was 22 inches by the gauge, having shewn 20 inches just before, and that by order of the acting engineman, he then put on *additional* weight, (how much he does not say,) and that two or three minutes afterwards, the boiler blew up. Another witness says that about the time the agent came on board, (some say 25 or 30 minutes before the explosion,) the gauge stood at nine inches.

This testimony agrees in showing that the pressure a half an hour before the accident, was 9 or 10 lbs. per inch, and that just before the boiler burst, it had risen to 22; higher than this it was not observed, except by a person who states that he saw the gauge-stick run up to the deck over it, immediately before the explosion. The evidence, also, of the witness "who put on the additional weight," that the pushing out of the weights *belonging to the valve*, as far as they would go, created a pressure of 22 lbs. per square inch, is confirmatory of the above estimate of the extreme pressure ($23\frac{6}{10}$ per square inch) which those weights were capable of producing, the difference of $1\frac{6}{10}$ lbs. being accounted for by the consideration that the elasticity of the steam would not instantly rise to an equilibrium with the increased pressure imposed by pushing out the weights, and that before the witness could observe whether the valve blew at $23\frac{6}{10}$ lbs. per inch, he had charged it still further with *extra weights*. That any extraneous means were employed to keep the valve down, has been denied by another witness, as I am informed, and have stated before; but the probabilities of the case are so much on the side of the positive declaration of the first witness, that an inquiry into the relative credibility of the two seems unnecessary. It being admitted, then, that new weights were added to those proper to the valve, the next question is, what must they have amounted to, in order to produce the explosion? The compound *leverage* of the valve is, as shown above, $\frac{1}{16.128}$ and its area, $204\frac{2}{10}$ square inches. The extreme presure it could bring upon the boiler, by its own weights, was $23\frac{6}{10}$ lbs. er square inch. The utmost pressure that the boiler could bear, is stimated at $69\frac{44}{100}$ lbs. per inch. Weight enough to raise an addiional pressure of $45\frac{84}{100}$ lbs. per square inch, must then have been ttached to the end of the valve lever, and, in order to effect this, the ew load must have amounted to 580 lbs. Now it seems very unikely that a weight, or weights, of such size or number, were in fact ung upon the valve lever, as that could scarcely have been done vithout detection, and it was manifestly intended to be a concealed ct on the part of those engaged in it. The extra stress upon the alve, necessary to cause explosion, was then, most probably, proluced by another mode than the suspension of weights from the lever —such as tying it down by its cord, or bracing it down by a strut beween it and the upper deck—notwithstanding the averment of the vitness, who may still have added new weights, but only to the exent of a part of the required surplus pressure, leaving the rest to be ffected by other means applied by other hands. No matter however n what way the valve was kept down, so that it raised, as it did, the ressure to the explosive height, whatever that may have been.

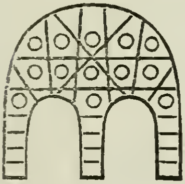
But the boiler may have been in fact weaker than it has been estinated, from a deficiency of strength in the iron of which it was made, nd which has been assumed at 55,000 lbs. per square inch. The umerous experiments that have been made upon the strength of this netal (of which those recorded in the Journal of the Franklin Instiute, vols. xix and xx, 2nd series, are the most extensive and satisfacory that I have seen, and also the most applicable to the present case, s they were made upon boiler iron,) show that its cohesive power s often exceeds as it falls short of that measure, which may be taken s a fair average. If the iron of the Medora's boiler was, in fact, of bad quality, it may, however, have possessed a tenacity far within hat just given; but it scarcely could have descended as low as the onehird of 55,000 lbs., or to 18,000 or 19,000 lbs. per square inch, which it must have done to have yielded to the steam pressure of $23\frac{6}{10}$ lbs. per square inch, supposing the preceding estimates of strength and pressure to be correct. My examination of the iron, as it appeared on the torn edges of the sheets, did not impress me with an unfavorable opinion of its quality, although it showed the distinctly laminous structure which most sheet iron exhibits. Its strength in the ruptured parts could not have been diminished by over heating, for those parts were far under the lowest level to which it is in the least degree probable that the water could have fallen, even had it declined below a safe and proper height. Moreover, the *strips*—the giving way of which caused the bursting of the boiler—were so situated that the fire could not have been at all in contact with them had the boiler been *dry,* as they occupied the spaces over the legs, and, consequently, must have been always immersed either in water or steam. There is, however, no evidence that the water was deficient in quantity at the moment of explosion; on the contrary, many witnesses declared that the gauge cocks showed a full supply, and, considering the vast size of the boiler, the shortness of the time between the lighting of the fire and the occurrence of the explosion, it seems not likely that the evaporation could have sunk the water to a dangerously low level, if, as is to be supposed, it was properly filled at first. I could, indeed, discover no trace of injury to any part of the boiler by burning of the metal, and my examination of the uppermost tubes, and the top of the back smoke chamber, was very careful, and if these parts of the boiler *were* overheated, they, nevertheless, stood firm, and left the rupture to take place elsewhere. No incrustations likely to impede the transmission of the caloric to the water, and thus render the iron liable to burn, anywhere appeared, and were not to be expected in a perfectly new boiler. The degree of heat imparted to the parts of the boiler covered with water, would not, at all events, have exceeded the temperature due to the effective pressure of about $4\frac{2}{3}$ atmospheres, or $69\frac{44}{100}$ lbs. per square inch, which has been above estimated as sufficient to burst the vessel. This temperature (see Journal of the Franklin Institute, vol xvii, page 291, 2nd series,) is not more than 300 degrees of Fahrenheit, and the experiments recorded in the same Journal (vol. xx, pages 24 to 31, 2nd series, and curve-traced in plate X,) show that the tenacity of iron is *increased* by heat, until a temperature of at least 400 of Fahrenheit is surpassed, when it begins to diminish. The boiler, then, could not, in my opinion, have burst from overheating the metal *in the parts where the rupture actually took place*—to wit, in the strips over the legs, uniting the segments of the cylinder between them. In estimating the strength of these strips, I have supposed, from inspection and measurement of those that remain, that they contained one-half of the original quantity of metal in the sheets, which was further reduced to one-third of that quantity by the rivet holes. In this estimate there is room for mistake, and, possibly, I may have in this assigned more strength to the boiler than it in fact possessed. In both the quality of the iron and the amount of metal in the strips, then, there may be room for considerable reductions upon the preceding calculations of the ability of the boiler to withstand the pressure of the steam. Again, although the metal did not, on account of its greater strength than that of the strips, give way where, if at all, it must must have overheated—viz: in the top of the smoke box, or in the upper flues—there is a possibility that these parts may have been laid dry by the falling of the water, and have become so hot as to generate suddenly a larger body of vapor (or, who knows, an explosive gas,) than the safety valve could vent with sufficient rapidity to save a rupture, even if that had been loaded to less than the strength of the boiler. This supposition is, however, in the face of the *evidence,* though, unfortunately, too little credit is due to such testimony in cases of this kind.

It is stated, by several witnesses, that the safety valve did not *blow* at all while the steam was getting up, and that from the time of making the fire, up to the moment of the explosion, not more than two or three short *puffs* proceeded from it. These would, indeed, suffice to show that it could not have stuck fast in its seat from the action of some adhesive force—an instance of which kind is on record. But it also proves that if, after all, the valve was not overloaded, at least the engineman and his assistants, &c., were strangely indifferent to the unusual absence of that audible evidence of its free action, which always attends the starting of a steamboat.

Although doubt must continue to rest upon the true and special cause of the explosion of the boiler of the Medora, and I am not prepared, in relation to that cause, to offer more than the preceding facts and inferences, for the judgment of others, yet some general conclusions may, I submit, be satisfactorily derived from the circumstances of this catastrophe. First—the boiler was too large in its diameter for the strength of metal employed, looking to the risk of bad material and workmanship. The thickness of the sheets was a quarter of an inch—a thickness, by the way, almost universally employed in the construction of steam boilers of all diameters, as if there were some magic in this particular dimension, which made it most pliantly applicable to all cases, however varying. Referring to the formula $x = \frac{2 \mathrm{P} t}{\mathrm{D}}$ we find that iron one-quarter of an inch thick would require a pressure of 573 lbs. per square inch to rupture it in a cylinder of three feet diameter, (a diameter of usual occurrence in locomotive and other high pressure boilers,) if the modulus of its strength be 55,000 lbs. per square inch, and a deduction be made *for the seams,* of twenty-five per cent. While the Medora's boiler, of eleven feet diameter, and the same thickness and strength of sheet iron, would have borne but 156¼ lbs. per square inch, with a proportional reduction of one-quarter for the joints, (saying nothing of the still greater subtraction of strength due to the apertures over the legs,) can there be any propriety in using the same thickness of plate for each of these widely differing diameters? Yet it is done under the influence of the apparently *prescriptive right* of the quarter inch iron to be employed in all cases whatever. It is true that the small diameter boilers are high pressure, and subjected to the greater strain, but their excess of strength is, at the same time, vastly greater than that of the large low pressure boilers. The usual high pressure strain is, perhaps, about 100 lbs., and the low pressure strain, 25 lbs. per square inch. The excess of strength in the three feet high pressure boiler is, then, 473 lbs. per square inch, and in the eleven feet low pressure boiler of the Medora, it would be but 126¼ lbs. per square inch. It may be said, indeed, that the ultimate strength of the former is but 5.73 times its usual strain, while that of the latter is 6.25 times its ordinary stress; also, that at the high temperatures accompanying high pressures, a given increase in the temperature causes a more rapid rise in the pressure than at the low temperatures of the lower pressures, so that there is occasion for more excess of strength in the former than in the latter cases, to guard against accidental augmentations of temperature. Also, that the consequences of explosion at high pressures are more disastrous than at those of a lower grade, and should, therefore, be more carefully guarded against. There may be some propriety in the two first of these suggestions, but not so much in the last, as some of the most fatal explosions have occurred in low pressure boilers; and still I think that low pressure boilers, whose diameters are generally from eight to nine feet, are usually too weak when made of quarter inch iron; and this opinion is held á fortiori in regard to the Medora, with her boiler of eleven feet across. Braces are indeed used in these large boilers, but with often only partial effect, and in the Medora, as has been already remarked, they could not be applied in the vertical, or radial, direction, in which they would have done most good, on account of the positions of the tubes.

Second—a boiler of the colossal size of that of the Medora, presents a bold and striking aspect, and seems fitted for the generation of a vast supply of steam; and so, doubtless, was the boiler in question, the fire surface and steam room of which was of unusually ample extent. But the same fire surface will be as effectual if distributed among two or three boilers, and with great increase of security against explosion. The one large boiler will, perhaps, cost less in the manufacture, and occupy less room in the boat, but it will be much more difficult to move, in placing and displacing it; and if accident happens to it, the supply of steam is wholly cut off; while with more than a single boiler, each of which can be insulated from the other, it may be kept up, and the engine worked at a lower speed, till the injured boiler is repaired.

Third—the design of a boiler resembling the Medora's, is deficient in strength at the junction of the belly with the legs which support it, and form the sides of the fire-place. The perforations of the cylinder *must* be large enough to permit the water and steam bubbles to pass freely up and down, in the necessary circulation of them through the boiler. *Small* holes over the legs would not allow this; the circulation would be checked, less steam would be generated, and the legs of the boiler become unduly heated for want of the constantly required supply of cold water, which, in a boiler with no obstruction to circulation, is constantly descending towards the fire, from the upper and cooler parts of the vessel—towards which last, the steam bubbles are simultaneously rising to the steam chamber; the two currents thus running contrary to each, without mutual interference, as their very different specific gravities maintain an easy separation between them. Thus the *vertical* has an advantage, in regard to circulation, over the *horizontal* tubular boiler; the tubes of the former interfering much less with the passage of the two counter currents, and its fire-place being at the *bottom* of the boiler, instead of at one end of it, horizontally, gravitation gives more assistance to circulation. The maker of the Medora's boiler was right, therefore, in giving wide passages for water into the legs, but, as to do this necessarily weakened his boiler so much, it shows a faultiness in its plan. It is not, indeed, easy to see why he departed from the usual mode of building boilers of this character by arching the fire-places as in the accompanying drawing, and so arranging his flues as to permit numerous ties in a radial direction across the boiler, connecting the outer shell with the fire-arches, as well as the flues. Here no cutting of holes would have been required, and any degree of strength given without interference with circulation. The ties introduced into the Medora's boiler, are not in the most effective position. A tie, or brace, in a cylindrical boiler, should never, if possible, occupy any other position than that of a perpendicular to the surface, supported by the tie, or brace. Here they are *diagonal* to the ends and roof, and as chords, *less than diameters*, across the cylinder.



Some other obvious remarks suggest themselves, in conclusion, and are generally applicable to steamboats when under trial, on such occasions as this ill-fated vessel was about to begin.

Most of the persons on board the Medora, at the time of her explosion, were, as before stated, workmen who had been engaged in her construction. It was not safe to leave the boat as it *was* left, in the hands of these men, most of them, probably, reckless of danger, by character, and fired with the false ambition congenial to the occasion. The safety valve and mercurial gauge should have been constantly under the eye of the engine builder, whose machine was being submitted to proof. The valve lever and its attached weights, and the means of moving them, should have been so constructed, and surrounded by guards, as to make it impossible that more than the extreme pressure designed to be put upon the valve, could be applied without doing violence to the defences of the apparatus. The boiler (as should all steamboat boilers,) should have been provided with a small pumping steam engine, to keep up the water, as at such times, especially, the boat has often to wait a good while before starting, the water gets low, and the engineman and his *assistants* (viz: the crowd around him,) are too excited, and anxious for a quick and favorable commencement of the trip, to go to work at the drudgery of pumping up by hand. Frequent trials of the state of the safety valve should be made, and it should not be left to *blow of its own accord,* at a safe pressure, but should be raised by force, and the surplus steam permitted to escape. This would prevent the valve from *adhering to the seat,* as it has been known to do, in consequence of the rusting of the iron, or the introduction of some glutinous, or cohesive, matter, thereto. The propriety of these and similar precautions, need not be enlarged upon. It is remarkable, and yet a clear consequence of the laws of mechanical *momentum,* that, in all these explosions, the rents made in the vessel should be so much greater than necessary to vent the steam and water with the rapidity that one would suppose far more than sufficient to relieve the pressure upon all other parts of the boiler than the part *first ruptured,* so much as to save them from injury. While the confined fluid is quiescent, however powerful its effort to escape, it does no harm, except in the preparation it is making to force an outlet, by gradually increasing its strain on the metal until an equilibrium is attained between the two forces of impact and resistance. But the instant that equilibrium is passed, upon a single square inch of the vessel, and the imprisoned fluid begins to put itself in motion, it breaks its way out, in a hundred directions instead of one, and we see parts of the vessel, of extremely unequal strength, giving way at the same moment. Thus in the Medora's boiler, the drawing shows several pieces blown out at the back, which were unquestionably far stronger than the strips of metal over the legs. The sudden escape of the steam and water, also, acting on the sides and bottom of the boat, give to the boiler that projectile force which throws it, en masse, into the air, and inflicts other great injuries in its fall. In all considerable explosions, indeed, the boiler has been more or less *displaced.*

Thus is demonstrated the unsoundness of the opinion that *simple pressure,* steadily increasing, within a steamboiler, ought to open the *seams,* as being the weakest part of the vessel, and thus provide a safety valve, for the escape of the vapor. To account for the fact that boilers *never do give way in this manner,* the hypothesis of explosive gases has been paraded with, as I humbly conceive, very little foundation in fact, although rare instances of that description may have occurred, under particular circumstances.

Baltimore, August 2nd, 1842.

To the Committee on Publication:

Gentlemen—Having received the annexed *Official Report* from Major Baker, Commandant of the United States' Arsenal at Watervliet, New York, (where the preservative process has been several years in operation,) I hand it to you for publication, not doubting you will consider it as sufficiently a subject of general interest to entitle it to receive publicity through your Journal.

Respectfully, your ob't serv't,

Edward Earle.

Watervliet Arsenal, June 6th, 1842.

Report of the comparative Strength and Elasticity of Mineralized Timber and that in the Natural State.

To Major R. L. Baker.

Sir:—I have submitted to the proving machine twelve pieces of each kind, comprising oak, maple, birch, whitewood, or tulip tree, and pine.

The principal data recorded were—

1st.—Deflection with the constant weight of 383 lbs., (weight of apparatus.)

2nd.—Greatest deflection and weight while the elasticity was perfect.

3rd.—Ultimate deflection and *breaking weight.* The deflection was also generally taken for every additional weight.

Five minutes were allowed for a *set,* five minutes for *resilience,* and five minutes between each 20 lbs. added near the breaking point.

The proof pieces were 2 inches square, and 48 inches of effective length, prepared in November, 1840, by sawing blocks of large timber lengthwise, into battens, which were carefully finished by the plane to a square of 2 inches, and the weight of each taken to within 3 grains. One half of the battens from each prism of timber were selected for mineralizing, by taking, from a map of the end, every second piece over the whole area. They were mineralized in November, 1840, and since that date both kinds have been constantly in store, and seem ***absolutely dry***, many of them having lost from one-sixth of a pound to one-fifth of their original weight. It is somewhat remarkable that birch has lost less than other kinds, and some pieces have increased in weight from a few grains to more than a pound.

In the oak, pine, and whitewood, the average of the breaking weight was greatest in the mineralized pieces, equal in those of birch, and a little less in maple. Being called to other duty, the number of proofs in maple and birch were too few to be satisfactory; but thus far, the results lead to the decision that Dr. Earle's process ***does not reduce the strength*** of timber. The elasticity seems a little diminished in several, and perhaps further experiments may show some corresponding increase of strength.

Tabular Comparison.

	Mineralized.		Unprepared.	
	Greatest deflection.	Breaking wt.	Greatest deflection.	Breaking wt.
Oak	2.37	1256	2.06	1226
Maple	1.50	1469	1.36	1617
Birch	1.00	808	1.15	1014
Whitewood	1.55	965	1.95	931
Pine	1.25	729	0.82	589

Two contiguous battens on the map were selected—one cured, the other raw—and each reduced one-eighth of an inch on each face, to remove the part, if any, injured by the heat, and to render them of one size. The cured broke with 1022 lbs.; the other with 988 lbs.

A number of pieces of different kinds of timber were intentionally operated on *excessively*, by *repeated* and long boilings. In *all of these* which have been tried, the strength *appears diminished* in a slight degree.

All my observations, thus far, tend to corroborate the suggestion that *boiling heat is not necessary*, and that long digestion* is important; and, to prevent checking when taken out, that the timber ought to be *cooled in the tank.*

Respectfully submitted,
(Signed) R. M. Bouton.

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* By "long digestion" is meant, a more protracted digestion than has been hitherto employed—that is, from one to two, three or more days, according to size, length, and kind of timber; and at a temperature short of the *boiling point*, or at 170 ° to 180 ° Fahr. A *short boiling*, of an hour or two, however, is recommended for timber of great size and length.
E. E.

To the above you will, I hope, permit me to add an extract which seems quite pertinent, from the last semi-annual Report of T. Tupper, Esq., President of the South Carolina Canal and Railroad Company, who has since last year been using this process on the railroad between Charleston and Hamburgh, South Carolina. Referring to a late advantageous purchase of timber for the road, (*at one-half the usual price*,) he says:

"This timber is obtained at a reduced price, as the sap is embraced in the square of the piece, and, consequently, taking a much less tree than when the heart only is retained.

"The advantage of this process will be felt at once in the lower price at which the timber is contracted for, and should it only last as long as ordinary timber, no expense will have been incurred, as the difference in the price of the timber will pay the expense of preparation.

"The timber prepared four years ago, with corrosive sublimate, is still sound, the sap of which has already shown a durability of double that of unprepared wood, and, from all appearance, will be sound when the unprepared is so rotten that it cannot be separated from the earth in which it is buried."

Here is a most important fact ascertained—the effect of corrosive sublimate on the sap-wood of timber—from which President Tupper derives the practical and useful inference that the sulphates of iron and copper—which have been fully ascertained to affect timber in the same manner as corrosive sublimate—must also render sap-wood, at least as durable as the heart is without them, and, by thus reducing the price of timber *one-half*, annihilate the cost of the process.

E. Earle.

Philadelphia, September, 1842.

Sketch of a Self-acting Flash-board, invented by Mr. John Chase, *and now in use upon a Mill-dam at Cabotsville, in the state of Massachusetts. Communicated by* E. P. Huntington.

The diagram below is an end view of a dam, with a self-acting flash-board, on a scale of one-twelfth the size. It was invented by Mr. John Chase, agent of the Springfield Canal Company, Cabotsville, Massachusetts, and is now in use there. Its design is to obtain a permanent additional supply of water in a mill-dam, equal to six inches head, and at the same time to avoid damage from back water, to those using it on the stream above, when it is high. Its cost is about three dollars per foot lineal.

Description of the Sketch.

A, pond.

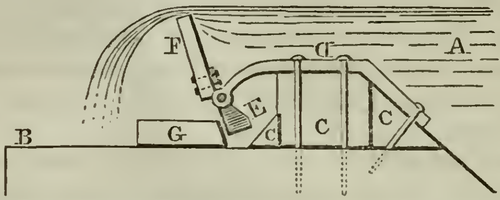
B, top of dam.

C, C, C, timbers spiked on the top of the dam.

D, iron to support flash-board—two to each section of eight feet.

E, bottom part of flash-board of cast iron, made heavy, to counterbalance the weight of water against the top, F, which is oak. Each section is eight feet long.

G, timber which resists the outward pressure of the flash-board, and to which it is hooked when turned down.



By this arrangement, when the water rises to about two inches above the top of the flash-board, the pressure is sufficient to carry the top, F, over to G, and as the water falls, the pressure is less, and it rises—*thus providing a due supply, but never an excess, when the water is abundant.*

Description of a new Self-acting Weir and Scouring Sluice, invented by Mr. Bateman, *an English Civil Engineer.*

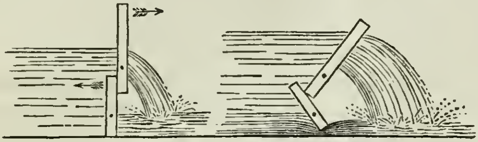
We find in the London Civil Engineer and Architect's Journal, for August, 1842, the following account of a self-acting weir and sluice, brought before the British Association for the Advancement of Science, at their late meeting, held at Manchester.

This sluice is an ingenious application to a different use of the same principle of action that is brought into play by Mr. Chase, in the flash-board above described; and it seems to us that upon light streams, Mr. Bateman's invention might often be made a valuable auxiliary to the works necessary for a flash navigation.

Mr. Bateman observed that the great objections to fixed weirs and dams were, that by causing a partial stagnation in the water above them, they allowed the bed of the stream to be silted up by the deposition of mud, gravel, &c., whereas the proposed weir would adjust itself to the various changes in the condition of the stream, and prevent any filling up of the channel by making the stream clear itself.

Mr. Bateman's weir is composed of two leaves, turning horizontally on pivots, which are placed below the centres of the leaves, so that the upper portions of them shall be of much greater area than the lower. The upper leaf is also far larger than the lower, and turns in the direction of the stream, while the lower leaf turns against the stream, and overlaps the bottom edge of the upper leaf, and is forced against it by the pressure of the water. The comparative area of the leaves and position of the pivots, is so arranged that in ordinary states of the stream, the tendency of the current to turn over the top leaf is counterbalanced by the pressure of the water against the overlap of the bottom one, the counteracting pressures keeping the weir vertical and the leaves closed, the water flowing as usual through a notch in the upper leaf. But when the water rises above the usual level, the pressure above, from greater surface and leverage, overcomes the resistance below, and the top leaf turns over, pushing back the lower leaf, and thereby offering the least possible obstruction to the water, and giving a passage at the very bottom of the stream to the gravel or mud.

The following diagrams will explain the construction of the weir:



In answer to questions and objections, Mr. Bateman explained how difficulties arising from trees floating down, the complete turning over of the leaves, &c., might be obviated by suitable stops, grating, &c. Sir J. Robison observed that the Rotterdam Canal had weirs on a similar principle, but Mr. Bateman explained that those weirs turned vertically on their axis. Mr. Vignoles stated that from the cheapness and apparent advantages of this weir, he hoped it would be brought under the consideration of the Commissioners of the Shannon navigation, and recommended for trial on that river, to which it appeared peculiarly applicable.

Mr. Bateman, in obviating some difficulties suggested, explained that in a weir 20 feet long and five feet deep, which his drawings and model might be supposed to represent, the sum of the closing pressures would be 7956 lbs., and the sum of the opening pressures would be 7669 lbs., the pivots being so placed as to give the areas of leaves, above and below the lines of their axes, the ratio of two to one. The leaves would consequently be kept close by a force equal to the difference between these pressures—that is, 287 lbs. As the water rises these conditions would, however, be changed. Supposing the water to rise one foot, the additional pressure would be 1200 lbs., of which 800 lbs. would be exerted in opening, and 400 lbs. in closing, the leaves; and the result would be, that the sum of the opening pressures would exceed that of the closing, by 100 lbs. The leaves would, consequently, be opened. He also explained that the sills against which the gates are made to close, might be so regulated as to discharge the greatest floods of water without allowing the leaves to open more than a moderate quantity; if thought necessary, however, the gates ought to be allowed to assume a position perfectly horizontal in cases of high floods, and thereby oppose the least possible resistance to the passage of the water. The sluice might also be protected from being choked with trees and brushwood floating down the stream, by means of a grating.

Franklin Institute.

Address of S. V. Merrick, *Esq., President of the Franklin Institute, preceding the reading of the Report of the Committee on Premiums and Exhibitions.*

Ladies and Gentlemen:

We are again assembled to perform a grateful duty—to mete out the reward to superior skill and ingenuity. This is the twelfth occasion on which this Institute has drawn together the products of American industry; each time with the gratifying result of being able distinctly to mark the progressive improvement of our countrymen in all the arts necessary to the comforts of man.

Those among us familiar with the history and acts of this institution from its formation, and who can trace from step to step the development of the arts, as evinced by its exhibitions, compare with pride and pleasure the display which has now been made with those of former years, and especially that held in 1824, the first experiment of the kind in this country.

At that period, almost the existence of a national manufacture at all commensurate with the wants of the people, was doubted. So great was the prejudice against the American fabric, that the manufacturer who had made any progress towards perfection was, in many cases, obliged to dispose of his products as foreign. The astonishment of the public who were then for the first time made acquainted with the existence of many branches of art which the collection at the Institute opened to their view, and the patriotic feeling which manifested itself, gave a strong impulse to our infant manufactures, and determined the Institute to continue its course, and periodically to collect and display the specimens of art, for the purpose of showing at a single glance the progressive advancement made by the American manufacturer towards perfection.

In these efforts, the Institute has been amply sustained by the skill of the producer, the zeal and industry of its committees, and the liberality of the public.

All parties have appreciated the importance of these periodical exhibitions to our *common* country, and all in their respective spheres have lent efficient aid, and none more so than our fair friends, without whose countenance and support no such enterprize, however worthy, can hope to succeed.

The present exhibition, although not the most extensive which has ever been accumulated under the care of the Institute, is by far the most perfect in most branches of the arts, and evinces so decided an advance towards perfection, as to warrant the belief that the day is not far distant when all the wants of the community may be supplied by domestic industry.

It is not in the coarser articles only that America is now independent of the foreigner. A glance over this hall will convince the most prejudiced that he need not blush to appear in an American coat. Nor is it any longer necessary to appeal to the patriotism of the ladies for the support of our manufactures. This room will furnish a female attire, from the bonnet to the shoe, which will bear a proud comparison with the products of any foreign country.

The manufactures of our country have taken deep root. The skill, industry, and ingenuity of our mechanics are unrivalled. Let the fostering hand of public opinion sustain them, and the whole community will reap the advantage. "United we stand—divided we fall."

The Report of the Committee on Premiums and Exhibitions, will now be read, with the award of premiums by the Managers. But, first, allow me to tender the sincere thanks of the Institute to the gentlemen of the Committee of Arrangement, who have devoted so much time to this collection and display—to the judges appointed on the various branches of manufacture, to whose prompt attention and impartiality we are indebted for this early award, and to the gentlemen of the public press, who, with untiring zeal worthy of the cause, have daily spread before the public full and judicious reports of all the articles in the saloon. To their liberality and public spirit, the Institute is especially indebted.

Report of the Committee on Premiums and Exhibitions of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, on the Twelfth Exhibition of American Manufactures, held in Philadelphia from the 18*th to the* 31*st day of October,* 1842.

The *Committee on Premiums and Exhibitions* report that, having brought their labors in reference to the awards of medals and certificates to a close, they respectfully present them to the Managers for examination.

The usual arrangements for holding the Exhibition of Domestic Manufactures were made, and the day of opening fixed for Tuesday, the 18th of October. Every endeavor was used to give publicity to the fact that the exhibition was to be held, and that it would be opened on *that* day, in order to avoid the disappointment to depositors resulting from too late a presentation of their deposits, which so frequently excludes them from the examination of the judges and the award of premiums. In all these preparatory steps, a zeal and interest was manifested by the Committee of Arrangement, which was an earnest of the efficient services rendered by them since the opening of the exhibition. These services must, and doubtless will, receive the best thanks of the Managers of the Institute, and of the mechanics and manufacturers generally.

The place of holding the meeting was, after much discussion, fixed at the Museum building. The advantages and disadvantages of the location—of the change from a suite of many rooms to a single large hall—and all other circumstances bearing upon the question, were fully considered. Notwithstanding that the prepossessions of the visiters must have been in favor of the former place of exhibition, the present locality appears to have given great satisfaction. By a division of the room by tables, for the display of articles, a sufficient length of show surface was obtained, and an extent of promenade afforded which satisfied even the most exacting. From certain points in the room, the general view was very pleasing, taking in at the same glance the numerous and varied objects of art and manufacture which filled the body of the room, and the moving groupes in the intervals engaged in their examination. The facilities afforded for putting the stoves and grates in action, have added much to the interest of one of the most useful branches of the exhibition; and the politeness of the occupants of the adjacent houses, and especially to Mr. Welsh, to whom the thanks of the Managers are justly due, enabled us to occupy a large area exterior to the exhibition hall and directly communicating with it.

There being but one chief hall of exhibition, has given rise to the impression that the number of articles exhibited is very considerably less than on former occasions. This, however, is by no means the case. It is true that the number and variety of the articles, in some particular departments, have not been quite so great as at the last exhibition, but this has been much more than counterbalanced by the choice nature of the specimens produced. In this respect, the present exhibition has surpassed all that preceded it. Notwithstanding the depression in all branches of industry, new fabrics and articles have appeared in many of the departments in useful lines of trade, and with a degree of perfection, and at prices which will secure a market for them.

Where so much merit appears, discrimination is invidious, and indiscriminate notice bears the aspect of fulsome praise. In illustration, however, of their position in reference to the excellence of the exhibition, the Committee would refer especially to the display of cotton, woollen, and silk goods; of stoves and grates, and of new and useful articles of hardware.

The judges have bestowed an amount of attention in the minute examination of the articles submitted to them, which merits the thanks of the Managers, and which should secure the approbation of the depositors. They have left but little more for the Committee to do than to make a compilation and very general revision of their labors. But two of the Committees of judges failed to present reports, most creditable to their authors. Each article, in turn, is commented upon, and the discriminating remarks show the unwearied patience with which these gentlemen have applied themselves to their work. It has been thought, by the Committee, that visitors should have an opportunity of examining the articles to which medals, or certificates of honorary mention, have been awarded. This new feature in the arrangements has required that the reports of the judges should be presented on or before the day when the awards are to be made. Some years ago, this would have been deemed an *impracticable result* to attain; but the interest now excited by the biennial displays of American ingenuity and skill, has increased; those immediately engaged in their superintendence feel the stimulus, and require merely that this much should be pointed out, to be resolute for its execution. All the reports, with the exceptions before noted, have been received.

In recommending to the Managers the awards, the Committee have, of course, in general, followed principally the indications of the Committee of Judges, exercising only the power reserved to them, that chiefly to make awards in case of special merit to articles which do not come within the lists of the judges. The particulars of the action of the Committee, may be inferred from the introductory remarks to each of the separate heads, or departments, into which the specimens have been classed.

Public attention has been steadily turned towards the present exhibition, and on each day since the opening, with the exception of one, when the weather was unfavorable, the attendance of visitors has been most encouraging.

The loss met with in the robbery of one of the offices for the receipt of money, has rendered every offering acceptable, and the Committee hopes that the community may be induced to remember this as a motive to return frequently, in addition to those of curiosity or interest in the exhibition.

As many of the scholars from the Public Schools, and other institutions, as the convenience of our visitors would permit, were invited to the exhibition, in the hope thereby to encourage early a spirit of admiration of the resources of the great country of which they are one day to be citizens. It was not one of the least interesting parts of the exhibition to see these eager and attentive throngs, passing with regularity and order through the windings of the hall, forming at times a continuous line, nearly from the door of entrance to that of exit.

All the attendant circumstances of this exhibition, with the exception before noted, have been of the most satisfactory character, and show that the system once understood, is readily managed by the Committees, and acquiesced in cheerfully by the depositors and the public generally. The Committee feel gladdened by these results. However toilsome the effort to the members of the Institute, their reward is ample. However troublesome to the manufacturers or mechanics, or to the depositors, their return is certain. All must be gratified in being instruments of public good, and the manufacturer and mechanic, especially, must feel that he has a full recompense for exertion in the sympathy of the public, with the successful efforts of American industry.

The Committee proceeds to pass in review the several divisions of the exhibition, commenting upon them, and stating the awards, which they recommend for the approval of the Board of Managers.

I.—*Cotton Goods.*

This branch of domestic manufactures has steadily and rapidly improved. The exhibition of this year was more remarkable for the excellence than for the extent or novelty of the fabrics. The improvement in printed goods was especially remarkable; a few years since foreign goods supplied our market in this branch almost entirely, now the domestic articles are so cheap, and of such good quality, as almost to exclude the foreign.

In accordance with the recommendation of the judges, the Committee makes the following awards:

To Perkins & Wendell, of La Grange, Philadelphia county, Pennsylvania, for No. 493, consisting of printed cottons, among which the judges specially designate a "light ground London style, and black ground Hibernia chintz," "three-colored stripes, and also rich green ground stripes." A Silver Medal.

To R. Garsed & Brothers, of Pennsgrove, Delaware county, Pennsylvania, for No. 263, deposited by them, cotton and worsted damask table covers, considered to merit a medal on account of novelty and excellence. A Silver Medal.

To James Wright, of Philadelphia, for No. 20, samples of Turkey red yarn, which possesses the qualities of eveness and strength, and has stood the action of chemical tests nearly as well as the imported yarn. A Certificate of Honorable Mention.

While in the opinion of the Committee this article is still inferior to the foreign, they desire to encourage the manufacturer to proceed in his efforts to bring it quite on an equality with the imported.

To Thomas Poole, of Philadelphia, for No. 21, cotton and worsted nett suspenders, remarkable for the smoothness and regularity of the web, and for strength and elasticity.

A Certificate of Honorable Mention.

To B. Starkey, of Philadelphia, for No. 92, quarter plaid ginghams, bearing a close resemblance to the Earlston gingham.

A Certificate of Honorable Mention.

The Committee of judges speak favourably of the work of other manufacturers. Their minute report, together with that of Dr. A. D. Chaloner, by whom the examination of the colors of the Turkey red yarn, No. 20, was made, will be published with the general report of the Committee. The importance of this branch of manufactures would induce the Franklin Institute to give every encouragement and all the publicity in their power, to the meritorious results of those engaged in it.

II.—*Woollen Goods.*

The display of woollen goods was varied, of superior quality, constituting one of the most prominent objects in the present exhibition. In accordance with report of the judges, the Committee has made the following awards:

To Edward Harris, Woonsocket, Rhode Island, for No. 468, deposited by him, merino cassimeres, "showing great skill, and a high degree of improvement in the manufacture." A Silver Medal.

To the Ballard Vale Co., Andover, Massachusetts, for No. 244, deposited by Paul Farnum & Co., consisting of white and scarlet flannels. A Silver Medal.

The judges remark of the specimens, that part of them possess the "unshrinking quality so highly prized in this article."

To the Rochester Mills, New Hampshire, for No. 475, very superior white Mackinac blankets, of remarkably pure and soft wool.

A Silver Medal,

To Duncan & Cunningham, of Belleville, New Jersey, for No. 471, deposited by them, seven embroidered woollen shawls.

A Certificate of Honorable Mention.

To the Middlesex Manufacturing Company, of Lowell, Massachusetts, for No. 488, deposited by Stone, Slade & Farnum, for four pieces of wool black cloth. A Certificate of Honorable Mention.

The judges considered these articles as remarkable for color, finish and quality.

To the Middlesex Company, Lowell, Massachusetts, for No. 488, deposited by Stone, Slade & Farnum, Belgic cord, a new article, in the manufacture of which, much skill and good taste are displayed.

A Certificate of Honorable Mention.

To the Middlesex Company, Lowell, Massachusetts, for No. 488, deposited by Stone, Slade & Farnum, double milled fancy cassimeres.

A Certificate of Honorable Mention.

To Wethered & Brother, Baltimore, for No. 469, double milled fancy cassimeres, to which the judges refer, especially to two pieces, as possessing the elastic property highly valued in French goods of this description. A Certificate of Honorable Mention.

To the Salisbury Company, Massachusetts, for No. 498, deposited by Waln & Leaming, scarlet and white flannels.

A Certificate of Honorable Mention.

The judges also speak favourably in their report of No. 576, four pieces of wool-dyed black cloth, manufactured by W. & D. Farnum, Waterford, Massachusetts, and deposited by them; of No. 470, white and scarlet blankets, made at the Rochester Mills, New Hampshire; of No. 520, wool-dyed black sattinetts, of fine material and strong fabric, manufactured by Wm. De Forrest & Co., Naugatuck, Connecticut, and deposited by Robert Grant.

Several very creditable articles in this department of the exhibition, were deposited too late to come under the notice of the judges.

III.—*Carpets and Oil Cloths.*

The Committee awards to the Thomsonville Manufacturing Company, Connecticut, for No. 419, deposited by Messrs. Hamilton & Daily, a two ply ingrain carpet, which, in the opinion of the judges, will compare advantageously with any article of the same kind now made. A Silver Medal.

To Andrew Johnson, of Cincinnati, Ohio, for No. 809, deposited by him, the best table oil cloth ever exhibited here. A Silver Medal.

To Andrew Alcorn, for an ingrain carpet, No. 139.

A Certificate of Honorable Mention.

To Hugh Smith, of Philadelphia, for No. 138, a list carpet, considered to be the best article of the kind exhibited.

A Certificate of Honorable Mention.

The oil cloths manufactured by Potter & Carmichael, and those by J. Macauley, Jr., are very excellent specimens, and will support the credit of the establishments where they were made.

To Wm. Silcox, of Philadelphia, for No. 518, manilla grass rugs, with woollen yarn borders. A Certificate of Honorable Mention.

IV.—*Silk and Manufactures of Silk.*

The specimens in this branch were very creditable to the manufacturers. The following awards are made:

To Mrs. H. McLanahan, of Philadelphia, for No. 351, three cases of reeled silk and sewing silk, for fringes, taken from an assortment kept for sale and not manufactured expressly for exhibition.
A Silver Medal.

To Samuel Ross, of Philadelphia, for No. 454, silk and hair damask seating, believed to be the first specimen of the kind yet exhibited.
A Certificate of Honorable Mention.

Beautiful specimens of the same kind of article, No. 717, manufactured by John George, of Philadelphia, richly entitled to a premium, were too late for competition.

To Wm. Morris Davis, Montgomery county, Pennsylvania, for No. 34, deposited by maker, two lots of raw silk, carried through the several processes from the worm to the hand, by the grower.
A Certificate of Honorable Mention.

To Miss A. E. Storer, of Philadelphia, for No. 351, one case of *reeled silk*, considered by the judges to be the best exhibited.
A Certificate of Honorable Mention.

To C. A. Walborn, of Philadelphia, for No. 24, stocks, part of which are made of American satin.
A Certificate of Honorable Mention.

To Geo. W. Ward, of Philadelphia, for No. 371, one case of stocks.
A Certificate of Honorable Mention.

To Ann Holt, of Philadelphia, for No. 207, six cards of silk covered buttons. A Certificate of Honorable Mention.

The judges also refer with approbation to a specimen of American satin, made at Economy, Pennsylvania.

As at former exhibitions, several deposites were made too late to be noticed, in accordance with the rules of the exhibition; the Committee regret to find on this list names which were excluded from the same cause from competition at the last exhibition.

An interesting letter from Mrs. McLanahan, giving particulars, which should form part of the documentary history of the silk manufacture in our country, is appended to the report of the judges. The Committee of Premiums has referred it to the Committee on Publications, to make such extracts from it as they may deem proper for publication in the Journal of the Franklin Institute.

V.—*Iron and Steel.*

The importance of this manufacture is felt by every intelligent member of the community, and its progress must be a source of legitimate congratulation. The depressed condition of the industry of our country has in no branch been more deeply felt than in this, and it cannot be a matter of surprise, though it is of regret, that the promise held out at the last exhibition of so decided advance, especially in the manufacture of iron with anthracite as a fuel, has not been realized. The report of the judges upon the specimens submitted, is referred for publication to the appropriate committee. The following awards are made:

To James Wood & Sons, of Philadelphia, for No. 492, two bundles of imitation Russia sheet iron, of surface equally smooth with the imported article and of uniform color, a new manufacture.

A Silver Medal.

Messrs. Yeardsley & Forsyth, of Chester county, Pennsylvania, for part of No. 143, deposited by Morris & Jones, viz: a boiler head of rolled iron, 48 inches in diameter and half an inch thick.

A Certificate of Honorable Mention.

The judges also refer with commendation to a bar of rolled iron from the Colemanville works, and to a round bar of axle iron by Valentine & Thomas, of the Bellefonte and Juniata Iron Works; also to No. 118, a bundle of nail rods, deposited by E. J. Etting & Brother.

VI.—*Umbrellas.*

This is a department of manufacture which is attracting increased attention, and the specimens in which have been very creditable to the depositors. The judges recommend, and the Committee makes the following awards:

To Wright & Brothers, of Philadelphia, for No. 453, consisting of hollow ribbed steel frame silk umbrellas, with patent springs; of silk umbrellas with whalebone frames, and of gingham umbrellas of American gingham, rendered water proof by a cheap composition.

A Silver Medal.

To J. Morris, Heston & Co., of Philadelphia, for No. 189, a light colored parasol with the handle inlaid with mother of pearl.

A Certificate of Honorable Mention.

To McGowen & Brothers, of Philadelphia, for No. 202, a light colored sun shade. A Certificate of Honorable Mention.

VII.—*Lamps and Gas Fixtures.*

These were few in number, and the judges recommend no special awards. The lamps for burning camphine and lard, were good specimens of the modes of applying these materials to the purpose of illumination, and the display of lamps and gas fixtures by Cornelius & Co., sustained the character of these gentlemen for taste and skill.

VIII.—*Hardware and Cutlery.*

This branch of domestic industry present considerable novelty from year to year, owing to its rapid progress. The specimens exhibited this year, though not so numerous as at the last exhibition, were of remarkable excellence. The display of guns and rifles is especially praised by the judges, to whose report the Committee refers for the particulars of the exhibition of hardware and cutlery. Great pains have been taken in examining the various articles, and the report upon them by the judges is so full that the Committee has merely to follow it in making the awards. The following are accordingly made.

To George Machin, of Philadelphia, for No. 124, a card of files and rasps, comparing favorably with the best imported articles of the same kind. A Silver Medal.

A question having been raised in reference to the manufacture of these articles, the judges obtained evidence entirely satisfactory to them, that they are of domestic workmanship.

To Bradley & Beecher, of Naugatuck, Connecticut, for No. 295, two cases of pen and pocket knives, of excellent quality and various patterns. A Silver Medal.

To the New England Screw Co., Providence, Rhode Island, for No. 345, deposited by Curtis & Hand, for samples of screws of most admirable workmanship. A Silver Medal.

To R. Heinisch, for No. 243, a case of tailors' and bankers' sheers. A Silver Medal.

The judges recommended an award for No. 510, specimens of iron butt hinges, made by W. Hart Carr, combining strength and durability with cheapness, but as Mr. Carr is a member of the Board of Managers, the regulations of the Institute forbid the award.

To L. Goujon & Sons, of Philadelphia, for No. 51, wood screws and rivets. A Certificate of Honorable Mention.

To E. Hunt & Brothers, of East Douglass, Massachusetts, for No. 109, six scythes, "well made, and worthy the attention of the trade." A Certificate of Honorable Mention.

To William Robinson, of Philadelphia, for Nos. 135 and 563, two rifles, considered by the judges beautiful specimens of American work, and a beautifully finished double barrelled gun. A Certificate of Honorable Mention.

To John Krider, of Philadelphia, for No. 283, a case of admirably made guns. A Certificate of Honorable Mention.

To the Home Manufacturing Company, of Birmingham, Connecticut, for No. 414, deposited by Wightman & Wilcox, sample of machine made pins. A Certificate of Honorable Mention.

To Homer, Foote & Co., of Springfield, Massachusetts, for No. 345, deposited by Curtis & Hand, a case of Screw wrenches. A Certificate of Honorable Mention.

To T. Rowland & Brothers, of Philadelphia, for No. 538, an elliptic spring, superior to any thing of the kind before exhibited here. A Certificate of Honorable Mention.

To G. & W. N. Ropes, Maine, for No. 702, deposited by Thomas Zell & Co., a card of well made knives and forks. A Certificate of Honorable Mention.

To Samuel Jackson, of Baltimore, for No. 447, deposited by George P. Schively, three pocket knives and one case of razors, skilfully and tastefully made. A Certificate of Honorable Mention.

To Tryon & Sons, of Philadelphia, for No. 848, a rifle and pistols, remarkably well made in every respect. A Certificate of Honorable Mention.

To Haywood & Sturdevan, for No. —, deposited by W. P. Cresson & Brothers, a box of machine-made horse nails.

A Certificate of Honorable Mention.

To James Barton, of Philadelphia, for No. 457, a lock for fire proofs.

A Certificate of Honorable Mention.

To Pierpont & Hotchkiss, New Haven, Connecticut, for No. —, deposited by W. P. Cresson & Co., two stands of door locks and knobs of excellent workmanship.

A Certificate of Honorable Mention.

To Rodenbough, Stewart & Co., of South Easton, Pennsylvania, for No. 345, deposited by Curtis & Hand, and by Livingston & Lyman, two bundles of fine iron wire, well polished and of uniform thickness. A Certificate of Honorable Mention.

To Spang & Wallace, for No. 80, an elegantly finished rifle.

A Certificate of Honorable Mention.

To Joseph McCredy, of Philadelphia, for No. 43, a case of woven wire for paper makers, one piece of which is of extraordinary width of excellent manufacture. A Silver Medal.

IX.—*Saddlery, Harness and Trunks.*

The specimens of these articles were by no means so numerous as at former exhibitions, nor so well calculated to attract attention. The judges speak well of them generally, and in accordance with their remarks, the Committee makes the following awards:

To Thomas Moyer, of Philadelphia, for part of No. 158, the trunk and saddle without a pad, which are severally considered to be the best exhibited. A Certificate of Honorable Mention.

To W. N. Lacey, of Philadelphia, for No. 107, a set of single and of double harness, calculated to add to the credit of American workmanship in this department. A Certificate of Honorable Mention.

To R. Carey, of Philadelphia, for part of No. 326, a shaftoe saddle, with a spring bar, and without a pad.

A Certificate of Honorable Mention.

To Francis, Field & Francis, of Philadelphia, for No. 205, consisting of saddlery ware, the japanned work of which is especially referred to by the judges. A Certificate of Honorable Mention.

To Mahlon Warne, of Philadelphia, for No. 505, a sulkey bridle without winkers, which vies with the same part of the "Ashburton harness." A Certificate of Honorable Mention.

To William P. Taylor, of Philadelphia, for No. 180, deposited by B. F. Taylor, a valise trunk. A Certificate of Honorable Mention.

X.—*Models and Machinery.*

The specimens of this important department were by no means as interesting as those presented at previous exhibitions. The judges reflect with considerable severity upon the character of some of the workmanship. Nevertheless certain of the articles were of great value in reference to the ingenuity of invention, and many were also very creditable specimens of work. The Committee makes the following awards, founded upon the detailed report of the judges:

To Alexander Calderhead, of Philadelphia, for No. 516½, a carpet loom, remarkable for its simplicity and efficiency.

A Silver Medal.

To John O. Bradford & Co., for No. 660, a knitting machine deposited by them, and made by Eastwick & Harrison, of Philadelphia, of the ingenuity and usefulness of which the judges speak very highly.

A Silver Medal.

To Parson & Wilder, Hoosick Falls, New York, for No. 99, deposited by J. B. Hughes, an improved cloth shearing machine.

A Certificate of Honorable Mention.

To Oare & Pittman, Lowell, Massachusetts, for No. 175, an improved machine for carding wool.

A Certificate of Honorable Mention.

To C. H. Eisenbrandt, Baltimore, Maryland, for No. 822, deposited by maker, a writing machine for the use of the blind.

A Certificate of Honorable Mention.

To T. Mason, of Philadelphia, (a youth,) for No. 315, a complete working model of a fire engine, very beautifully executed.

A Certificate of Honorable Mention.

The Committee further awards to W. A. Armstrong, of New York, for No. 751, a knife cleaner, well adapted to use in large families.

A Certificate of Honorable Mention.

Also to Samuel Pennock, of Kennett Square, Pennsylvania, for No. 871, an ingenious drilling machine, for planting corn, wheat, &c.

A Certificate of Honorable Mention.

The judges recommend for examination by the committee on Science and the Arts, No. 338, a model of a three-ply carpet loom, by J. A. Scott, No. 352, a model of a compound capstan, by R. C. Taylor, and No. 278, a stone cutting machine, by Hines & Houpt.

The beautiful self-acting medal ruling machine, by Joseph Saxton, of the U. S. Mint, excited general admiration. As Mr. Saxton is a member of the Board of Managers, no further notice can be taken of it here.

To J. M. Clintock, of Philadelphia, for No. 380, a mortising machine.

A Certificate of Honorable Mention.

The Committee would have made an award to Wm. Smith, of Philadelphia, for No. 813, a bank note transferring press, had it been brought to the exhibition in time.

A lathe by Charles L. Oram, is worthy of notice.

A fire engine, deposited by John Agnew, is very creditable to him as a manufacturer of this article. Mr. Agnew being a member of the Board of Managers, no award can be given to it.

XI.—*Stoves and Grates.*

In no branch of the exhibition has there been a greater amount of competition than in this. The specimens of stoves for parlors and kitchen use, and the cooking ranges were numerous, and the locality of the exhibition afforded an excellent opportunity for showing practically the various merits of the different forms. In all of those made of cast iron, the improvements in the art of iron founding were distinctly to be marked.

The judges were of opinion that no one of the cooking stoves was superior in usefulness and durability to some which have received the premiums on former occasions. The cooking ranges were in general those which have already met with commendation, one of them, however, presenting novel features, is recommended for the award of a medal.

As the opinion of the Committee of judges is fully given in their report, it has been referred for publication in the Journal of the Institute.

The Committee awards to Julius Fink, of Philadelphia, for the cooking range, No. 42, deposited by him. A Silver Medal.

To John Estlin, of Philadelphia, for No. 261, a cooking stove.
A Certificate of Honorable Mention.

To Pleis, Foering & Co., of Philadelphia, for No. 438, "a salamander stove with a very convenient appendage for heating sad irons."
A Certificate of Honorable Mention.

This stove is understood to be the invention of Mr. Frederick Foering.

To J. L. Mott, of New York, for No. 487, deposited by Dewitt C. Mott, consisting of several stoves, with new and ingenious contrivances. A Certificate of Honorable Mention.

To J. L. Mott, of New York, for No. 487, deposited by Dewitt C. Mott, a portable open boiler, or cauldron, and furnace.
A Certificate of Honorable Mention.

To Harned & Elliot, for No. 865, a parlor self-regulating stove, of remarkably neat form, for burning coal, combining great economy of fuel, with cleanliness.
A Certificate of Honorable Mention.

To Samuel R. Andrews, of Philadelphia, for No. 495, a cooking range. A Certificate of Honorable Mention.

To Samuel Lloyd, Philadelphia, for No. 667, a cooking range.
A Certificate of Honorable Mention.

XII.—*Cabinet Ware.*

No department of the decorative arts has shown more improvement than this, in the quality of the articles exhibited. The report of the judges is full and explicit, and containing hints which may be of service to this branch of art, is referred for publication.

To C. H. & J. F. White, for a sofa and chairs, "very superior specimens of design and workmanship." A Silver Medal.

To J. & A. Crout, of Philadelphia, for No. 121, a centre table of Lombardy Poplar, remarkable for "boldness and beauty of design, and elegance of workmanship." A Silver Medal.

To J. P. Sherborne, of Philadelphia, for No. 79, two dressing bureaus, "beautiful specimens of furniture, in the Tudor Gothic style."
A Certificate of Honorable Mention.

XIII.—*Musical Instruments.*

The judges have, as usual, given much attention to the examination of the instruments produced for exhibition. They speak highly of the pianos as presenting, on the average, an improvement upon those exhibited in former years, but do not consider the excellence of any one or more as sufficiently marked to require the award of the highest honors of the exhibition. Their report has been referred to the Committee on Publications. They notice especially No. 276, from the manufactory of Messrs. Reichenbach & Co., of Philadelphia; No. 521, from A. H. Gale, of New York, deposited by J. C. Smith; Nos. 282 and 246, from C. Meyer, of Philadelphia; and No. 123, from the Manufacturing Company of Philadelphia.

In accordance with their recommendation, awards were made,

To T. J. Weygandt, of Philadelphia, for No. 227, an eight keyed flute, remarkable for its strength of tone and fullness, and richness in the lower parts of the scale. A Certificate of Honorable Mention.

To J. Pfaff, of Philadelphia, for No. 396, an eight keyed flute, admired for the "sweetness and richness of its upper notes."
A Certificate of Honorable Mention.

XIV.—*Glass, China and Earthenware.*

One of the most interesting and generally noticed portions of the display at this exhibition consisted of the articles of earthenware.

The articles, No. 106, made by Abraham Miller, consisting of the finer kinds of earthenware, as plates, vases, and ornamental flower pots, were recommended for a premium, but in consequence of Mr. Miller being a member of the Board of Managers of the Institute, this cannot be awarded.

The Committee awards to the American Pottery Company, of Jersey city, for No. 31, deposited by Peter Wright & Sons, and consisting of embossed-ware jugs, tea ware, spittoons, &c., of spittoons with white raised figures, of druggists' jars, &c. A Silver Medal.

To the Boston and Sandwich Glass Company, for the best display of cut glass in the exhibition, deposited by W. M. Muzzey, S. Tyndale and James Kerr. A Silver Medal.

To the Union Glass Works of Philadelphia, for No. 147, deposited by Charles B. Austin, the best specimen of colored glass exhibited.
A Silver Medal.

To Coffin, Hay & Bowdle, of the Jersey Glass Works, for No. 159, deposited by them, window glass, showing improvements in this useful branch of manufacture. A Certificate of Honorable Mention.

To C. M. Greiner, of Philadelphia, for No. 9, specimens of painting upon porcelain. A Certificate of Honorable Mention.

It is to be regretted that the artist has expended so much labor and time in decorating an inferior porcelain article of foreign manufacture.

XV.—*Paper Hangings.*

Although the excellence of the specimens of paper hangings was as great as at the last exhibition, the number and variety was very much reduced. The Committee, nevertheless, agrees with the judges in the opinion that the intrinsic excellence of the articles presented by Howell & Brothers, entitles them to high commendation. The Committee awards to Howell & Brothers, Philadelphia, for No. 36, deposited by them, specimens of paper hangings in various styles.

A Certificate of Honorable Mention.

XVI.—*Books and Stationary.*

The judges speak in terms of high commendation of the improvement manifested in all the parts of what may be called the manufacture of books, including the paper, the typography, and binding, beautiful specimens of which have this year been exhibited. There was no novelty in the exhibition of paper; the same varieties, and from nearly the same makers, having been presented as at the last exhibition. Many articles of stationary were for the first time produced, with a perfection which must establish their use in the stead of the corresponding imported ones.

The printing papers of Tileston & Hollingsworth, of Milton, Massachusetts, and of H. V. Butler, of Paterson, New Jersey, are favorably noticed by the Committee of judges. The copper plate printing paper of Tileston & Hollingsworth, received special notice at the last exhibition, as was also the case with the colored papers for lining books, make by R. & A. H. Hubbard, of Norwich, Connecticut.

In book-binding, the Committee awards to Benjamin Gaskill, of Philadelphia, for No. 381, excellent specimens of book-binding.

A Certificate of Honorable Mention.

To Lippincott & Co., of Philadelphia, for No. 435, containing beautiful specimens of binding. A Certificate of Honorable Mention.

The judges particularly refer to the execution of the edition of Byron, which is one of the books exhibited in No. 435, highly commending every part of it, and especially noticing the stereotyping by Mr. Fagan.

To C. Carle, of Philadelphia, for No. 157, specimens of book binding, designed with taste and executed with skill.

A Certificate of Honorable Mention.

To Johnson & Smith, Philadelphia, for No. 1, containing specimens of types made by them.

A Certificate of Honorable Mention.

To Carey & Hart, of Philadelphia, for No. 385, the Gift for 1843, entirely of American materials.

A Certificate of Honorable Mention.

In the articles of stationary, the judges refer with the highest praise to the superior work of the Blank Books, manufactured by Hogan & Thompson, of Philadelphia; also to the steel pens, the wafers, sealing wax and ink, exhibited by them, for which, however, no award can be made on account of Mr. Thompson's position as a manager of the Institute. The blank books bound by Thomas Leitch, and by Messrs. Lippincott & Co., are also noticed.

The writing papers of Jessup & Brothers, of Westfield, Massachusetts, and of R. & A. H. Hubbard, of Norwich, Connecticut, were noticed at the last exhibition.

The Committee now awards—

To Joseph C. Robinson, for No. 391, deposited by Mr. Conrad, a beautiful specimen of large writing paper.

A Certificate of Honorable Mention.

To the Wading River Co., of McCartyville, New Jersey, for a specimen of cloth paper, contained in No. 455, deposited by Wm. McCarty. A Certificate of Honorable Mention.

The different black inks exhibited were found to be of good quality.

The admirable wall paper of C. & W. H. Magarge was noticed at the last exhibition.

The articles deposited by R. Lindsey & Co., fully sustained the reputation of that house, but were too late for competition.

XVII.—*Fine Arts.*

The following awards are made, with reference to the opinions expressed by the Committee of judges:

To A. Cornu, of Philadelphia, for No. 233; drawings of machinery, &c., executed with the pen, and remarkable for exactness and beauty.

A Certificate of Honorable Mention.

To J. Gibson, of Philadelphia, for No. 497; painted imitations of various woods. A Certificate of Honorable Mention.

To John T. Bowen, of Philadelphia, for No. 361½, specimens of colored lithographic prints, from drawings by Audubon.

A Certificate of Honorable Mention.

The judges also speak with commendation of No. 96, paintings of fruit, &c., by G. B. Ord; of No. 82, drawing of the excavator, for railroads, by S. R. Mason; of No. 462, imitation of crayon drawings, by Victor Ernette; of No. 850, machine drawings, by H. R. Campbell, and of No. 772, two views of the volcano of Katuca, in the island of Hawaii.

The Committee awards:

To C. K. Frost, of Philadelphia, for No. 70, beautiful specimens of engraving on wood, in different departments of the art.

A Certificate of Honorable Mention.

To T. Mumford, of Philadelphia, for No. 102, fine engravings on wood. A Certificate of Honorable Mention.

XVIII.—*Silver and Plated Goods.*

The report of the Committee of judges who examined the articles of this class, is clear and explicit; following its indications, the Committee of Premiums awards:

To Bailey & Kitchen, of Philadelphia, for No. 321, a silver tea service, with spoons, forks, &c., of beautiful design and workmanship.

A Certificate of Honorable Mention.

To Bard & Lamont, of Philadelphia, for No. 376, a fireman's horn, of silver, of fine proportions and finish.

A Certificate of Honorable Mention.

To Samuel Bland, of Philadelphia, for No. 209, a patent lever watch. A Certificate of Honorable Mention.

XIX.—*Book Binders' Tools.*

There can hardly be said to have been competition in this department of the exhibition, the specimens being in different branches of the art.

The following awards are made as most justly due by the intrinsic excellence of the work:

To Gaskill & Copper, of Philadelphia, for No. 23, containing various specimens of book binder's stamps, of beautiful workmanship, presenting improvement upon those heretofore exhibited by them.
A Certificate of Honorable Mention.

To Allen Leonard, of Philadelphia, for No. 166, a brass die for embossing, exhibiting, according to the report of the judges, skill, taste, and judgment. A Certificate of Honorable Mention.

The steel dies for embossing, No. 398, by A. C. Morin, fully sustain the character of the work of that artisan.

XX.—*Marble and Statuary.*

The committee makes the following awards:

To Joseph Maples, of Philadelphia, for No. 254, a small sarcophagus, of Italian marble, of creditable design and workmanship, and a slab, with a shield encircled by a laurel wreath beautifully wrought.
A Certificate of Honorable Mention.

To John McFadden, of Philadelphia, for No. 88, an Italian marble bath with figures inlaid, in imitation of Mosaic.
A Certificate of Honorable Mention.

XXI.—*Hats and Caps.*

Few of these articles were exhibited. The judges mention the hats deposited by Charles Oakford, as remarkable for the fineness of the materials of which they are made, and speak favorably of the hats and caps deposited by Charles F. Raymond, of the hats and military caps deposited by John Simpson, and of the beaver bonnet deposited by Emmor Kimber, Jr.

An award is made to H. S. Miller, Philadelphia, for No. 355, deposited by maker, six hat bodies, which are in the opinion of the judges the best exhibited. A Certificate of Honorable Mention.

XXII.—*Combs and Brushes.*

The following awards are made to the makers of these articles:

To S. Winner, of Philadelphia, deposited by maker, for No. 226, a case of combs, good in style and workmanship.
A Certificate of Honorable Mention.

To Meyers Busch, of Philadelphia, for No. 604, a case of fancy brushes. A Certificate of Honorable Mention.

The brushes made by the pupils of the Pennsylvania Institution for the instruction of the blind, No. 313, are considered decidedly better aticles than those submitted at the last exhibition.

XXIII.—*Coach Work.*

Some of the specimens under this head, were much admired.—Awards were made:

To Ogle & Watson, Philadelphia, for No. 504, deposited by maker, the Ashburton carriage, pronounced by the committee of judges to be of superior workmanship. A Silver Medal.

To A. Knowles & Co., Philadelphia, for No. 73, deposited by maker, two neat and well finished sleighs.

A Certificate of Honorable Mention.

XXIV.—*Leather and Morocco.*

This branch of the exhibition was meagre indeed, in the number of specimens presented. Without entering into the reasons which might be assigned for this, the committee would observe that the manufacturers of our city alone, have not been fully represented in this article, and would recommend to the enterprising members of this trade to let the public have a fairer sample as to the extent of their work at the next exhibition.

The articles deposited by Scattergood & Boustead, by Lippincott, and by A. & J. Peterson, fully sustained their high reputation for skill in their art.

The Bag Hide, by Scattergood & Boustead, is a fine article, and would do credit to any shop or market.

A Certificate of Honorable Mention.

XXV.—*Boots and Shoes.*

In accordance with the spirit of the report of the Committee of judges, the following awards are made:

To J. A. Sengenberger, of Philadelphia, for No. 177, the best specimens of boots and shoes exhibited.

A Certificate of Honorable Mention.

To J. Thornley, of Philadelphia, for No. 363, India rubber shoes, which show considerable improvement in these articles.

A Certificate of Honorable Mention.

The judges speak favorably also of the India rubber boots and shoes exhibited by John L. Ripley, and express a regret that some of the best specimens of boots and shoes were brought to the exhibition too late to come under their notice.

XXVI.—*Chemicals.*

The specimens of chemical preparations were very beautiful.—Those of Wetherill & Brothers, Harrison & Brothers, Carter & Scattergood, and Farr, Powers & Weightman, are all spoken of in high terms by the judges. The glass, for chemical purposes, manufactured by the New England Glass Co., and deposited by W. M. Muzzey, is strongly recommended to chemists.

The judges recommend the following awards which are hereby made.

To Carter & Scattergood, of Philadelphia, for No. 297, a very beautiful specimen of Prussian blue

A Certificate of Honorable Mention.

To Farr, Powers & Weightman, of Philadelphia, for the general excellence of the preparations exhibited by them, Nos. 406 and 407.

A Certificate of Honorable Mention.

The Committee awards:

To Eugene Roussel, of Philadelphia, for No. 224, the best display of soaps, perfumery, &c., yet exhibited. A Silver Medal.

XXVII.—*Philosophical Apparatus.*

This is a growing and useful branch of the mechanic arts. The Committee regards the execution of the meridian circle, by William J. Young, as marking a new era in the application of the arts. The report of the judges, which is very full upon all the articles, is referred for publication. The Committee in accordance with the recommendations of the judges, awards:

To William J. Young, of Philadelphia, for No. 872, a five feet meridian circle, or transit instrument, copied from the High School Transit of Ertel & Sons, of Munich. A Silver Medal.

To A. D. Crane, for No. 356, deposited by Smith & Brothers, of Philadelphia, a clock with a torsion pendulum, a curious and compact form of mantle clock. A Silver Medal.

To James F. Duffey, of Philadelphia, for No. 256, various electro-magnetic instruments of neat execution.

A Certificate of Honorable Mention.

To Thomas Hill, of Cambridge, Massachusetts, for No. 517, a machine for assisting in determining the occurrence of time of occultations and called an "occultator." A Certificate of Honorable Mention.

To James Bingham, for No. 519, various articles of electro-magnetic apparatus, neatly executed.

A Certificate of Honorable Mention.

To H. M. Paine & Co., of Liecester, Massachusetts, for No. 857, periscopic and cylindrical spectacles.

A Certificate of Honorable Mention.

The judges also speak in terms of warm commendation of a gold lever watch, No. 209, the movement of which, except the chain and main spring, was executed by Samuel Bland; of a case of watch dials, No. 210, by Wm. J. Mullen; and of an admirably finished theodolite, No. 244, by Edmund Draper.

In the spirit of encouragement to youthful efforts, which the Franklin Institute has always manifested, the following award is made:

To James Duffey, Jr., of Philadelphia, for No. 275, containing, among other articles of philosophical apparatus, a model of a combination of machinery. A Certificate of Honorable Mention.

XXVIII.—*Straw Goods.*

In accordance with the recommendations of the judges, the award is made:

To Miss Blake, of Wrentham, Massachusetts, part of a case, No. 443, deposited by Thomas White, a straw bonnet, the beautiful plaiting of the material of which was executed by her.

A Silver Medal.

XXIX.—*Surgical Instruments, &c.*

There was not much variety in these articles. In accordance with the report of the acting judges, the Committee awards:

To E. Flohr, of Philadelphia, for No. 430, a mounted cranium.

A Certificate of Honorable Mention.

To B. C. Everett, of Philadelphia, for No. 334, a case of surgical bandages. A Certificate of Honorable Mention.

The abdominal supporter by Dr. Banning, although coming too late to enter into the competition, is thought so highly of by the judges on surgical instruments, that the Committee awards it,

A Certificate of Honorable Mention.

XXX.—*Copper, Brass, and Plumbers' Work.*

There was very little variety in the articles classed under this head. The judges speak favourably of the copper tubes for locomotive boilers, No. 49, by Wayne & Roberts, of Philadelphia; of the large bell, No. 357, by L. Debozear, of Philadelphia; and of brass castings, by Isaac Babbit, of Boston.

XXXI.—*Tin Ware.*

The display of tin ware was not more various than on former occasions, the judges recommend, and the Committee awards:

To Harned & Elliott, of Philadelphia, for No. 274, a tin ball, or sphere, twenty-eight inches in diameter, for a steeple ball.

A Certificate of Honorable Mention.

XXXII.—*Paints and Colors.*

The specimens of paints and colors exhibited were highly creditable to the manufacturers. The judges recommend the following award which is hereby made.

To R. A. Tilghman, of Philadelphia, for No. 548, specimens of superior chromate of lead. A Certificate of Honorable Mention.

The judgment of the Committee on chemicals, in reference to the excellence of the Prussian blue, No. 297, of Carter & Scattergood, is confirmed by the judges on paints and colors, who also recommend it to Honorable Mention.

XXXIII.—*Fancy Articles.*

It is believed that the quality of the specimens of fancy articles was better than at preceding exhibitions. The following awards are made in compliance with the recommendations of the Committee of judges.

To Thomas Bogue, of Philadelphia, for No. 309, "a case of gentlemen's wigs and scalps." A Certificate of Honorable Mention.

To F. J. Dressler, of Philadelphia, for No. 422, a case of fancy hair work—the best exhibited. A Certificate of Honorable Mention.

To T. B. Smith, of Philadelphia, for No. 516, an assortment of pickles of excellent flavor. A Certificate of Honorable Mention.

To Joseph S. Dunlap, of Philadelphia, for No. 394, a jar of candy, the best exhibited. A Certificate of Honorable Mention.

The display of confectionary, by Mr. Parkinson, is very creditable, and evinces a high degree of excellence in this branch of manufacture. The beautiful pagoda, seven and a half feet high, of transparent candy, which ornamented the summit of the centre circular table, in the exhibition room, was made by him, and added much to the effect of the general view. A Certificate of Honorable Mention.

The Committee proposes to submit those of the reports of the judges which are most interesting, to the Committee on Publication of the Institute.

Practical & Theoretical Mechanics & Chemistry.

New Act of Congress providing for the Registering of Designs, and for Amending the Patent Law in certain particulars.

It has long been a subject of serious and just complaint that the laws of the United States did not afford any protection to the art of designing, as applied to a number of manufactures; the subjoined act of Congress removes this difficulty, giving an exclusive right to the author, or inventor, of any new design, for seven years. This protection will be very extensive in its application, and in a number of instances where patents have been refused under the laws previously existing, they may be obtained under that now presented. Many very ornamental patterns, for example, have been made for stoves, which have been got up in good taste, and at great expense; but as the article did not present any thing new in the principle of its construction and operation, a patent could not be granted for it.

There are a great number of cases in which it will not be possible to comply with the requirement of the last section of this act. If a person obtains a patent for improved pins, needles, nails, or screws, or for an improved liquid for burning in lamps, he will be at some loss in attempting to "stamp on each article vended, or offered for sale, the date of the patent." This appears to be a strange oversight in the wording of the law. If it had provided that whenever the word patent was stamped upon an article, it should be accompanied with the date of the patent, the thing would have been practicable. The phraseology of this section is obscure in other respects.

An Act in addition to an Act to Promote the Progress of the Useful Arts, and to Repeal all Acts, and parts of Acts, heretofore made for that purpose.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Treasurer of the United States be, and he hereby is, authorized to pay back, out of the patent fund, any sum or sums of money, to any person who shall have paid the same into the Treasury, or to any receiver or depository, to the credit of the Treasurer, as for fees accruing at the Patent Office through mistake, and which are not provided to be paid by existing laws, certificate thereof being made to said Treasurer by the Commissioner of Patents.

Sec. 2. *And be it further enacted,* That the third section of the act of March, eighteen hundred and thirty-seven, which authorizes the renewing of patents lost prior to the fifteenth of December, eighteen hundred and thirty-six, is extended to patents granted prior to said fifteenth day of December, though they may have been lost subsequently: *Provided, however,* The same shall not have been recorded anew under the provisions of said act.

Sec. 3. *And be it further enacted,* That any citizen or citizens, or alien or aliens, having resided one year in the United States, and taken the oath of his or their intention to become a citizen or citizens, who by his, her, or their, own industry, genius, efforts, and expense, may have invented and produced any new and original design for a manufacture, whether of metal or any other material or materials, or any new and original design for the printing of woollen, silk, cotton, or other fabrics, or any new and original design for a bust, statue, or bas relief, or composition in alto or basso relievo, or any new and original impression or ornament, or to be placed on any article of manufacture, the same being formed in marble or other material, or any new and useful pattern, or print, or picture, to be either worked into or worked on, or printed, or painted, or cast, or otherwise fixed on, any article of manufacture, or any new and original shape or configuration of any article of manufacture not known or used by others before his, her, or their invention or production thereof, and prior to the time of his, her, or their application for a patent therefor, and who shall desire to obtain an exclusive property or right therein to make, use, and sell and vend the same, or copies of the same, to others, by them to be made, used, and sold, may make application in writing to the Commissioner of Patents, expressing such desire, and the Commissioner, on due proceedings had, may grant a patent therefor, as in the case now of application for a patent: *Provided,* That the fee in such cases, which by the now existing laws would be required of the particular applicant, shall be one-half the sum, and that the duration of said patent shall be seven years, and that all the regulations and provisions which now apply to the obtaining or protection of patents, not inconsistent with the provisions of this act, shall apply to applications under this section.

Sec. 4. *And be it further enacted,* That the oath required for applicants for patents may be taken, when the applicant is not for the time being residing in the United States, before any minister, plenipotentiary, charge d' affairs, consul, or commercial agent, holding commission under the Government of the United States, or before any notary public of the foreign country to which such applicant may be.

Sec. 5. *And be it further enacted,* That if any person or persons shall paint or print, or mould, cast, carve, or engrave, or stamp, upon anything made, used, or sold by him, for the sole making or selling of which he hath not or shall not have obtained letters patent, the name or any imitation of the name of any other person who hath or shall have obtained letters patent for the sole making and vending of such thing, without consent of such patentee, or his assigns or legal representatives; or if any person, upon any such thing not having been purchased from the patentee, or some person who purchased it from or under such patentee, or not having the license or consent of such patentee, or his assigns or legal representatives, shall write, paint, print, mould, cast, carve, engrave, stamp, or otherwise make or affix the word "patent," or the words "letters patent," or the word "patentee," or any word or words of like kind, meaning, or import, with the view or intent of imitating or counterfeiting the stamp, mark, or other device of the patentee, or shall affix the same, or any word, stamp, or device, of like import, on any unpatented article, for the purpose of deceiving the public, he, she, or they, so offending, shall be liable for such offence to a penalty of not less than one hundred dollars, with costs, to be recovered by action, in any of the circuit courts of the United States, or in any of the district courts of the United States having the powers and jurisdiction of a circuit court; one-half of which penalty, as recovered, shall be paid to the patent fund, and the other half to any person or persons who shall sue for the same.

Sec. 6. *And be it further enacted,* That all patentees and assignees of patents hereafter granted, are hereby required to stamp, engrave, or cause to be stamped or engraved, on each article vended, or offered for sale, the date of the patent; and if any person or persons, patentees or assignees, shall neglect to do so, he, she, or they, shall be liable to the same penalty, to be recovered and disposed of in the manner specified in the foregoing fifth section of this act.

JOHN WHITE,
Speaker of the House of Representatives.
WILLIE P. MANGUM,
President of the Senate pro tempore.

Approved August 29, 1842.

JOHN TYLER.

On the Manufacture of Sulphuric Acid. Read before the British Association for the Advancement of Science, by Mr. William Blyth.

The ordinary process of manufacturing sulphuric acid, by introducing into a leaden chamber a mixture of sulphurous acid, red nitrous fumes, and common air, has been long practiced. Like many other improvements in the arts, it seems to have been more the result of chance than the application of scientific skill; and chemists remained long in the dark as to the true nature of the changes which took place in the vitriol chamber. The first satisfactory explanation was given to the world by Clement and Desormes, in 1806. These chemists discovered the white chrystalline compound which is now known to be formed when sulphurous acid, red nitrous fumes, common air, and the vapour of water, are mixed together, and exposed to a sufficiently low temperature. They also observed the remarkable property which it possesses of being decomposed when put into water, and of being resolved into nitric oxide and sulphuric acid. This fact they applied to explain the important part performed by the nitric oxide, in enabling the sulphurous acid to be still farther oxydized at the expense of the oxygen in the common air. The formation of the crystalline compound in the leaden chamber, its decomposition by the weak acid at the bottom of the chamber, and the evolution of nitric oxide to be again changed into red nitrous fumes by the oxygen of the common air—is the favorite theory of chemists at the present time, and seems to be now generally admitted. M. Adolph Rose, of Berlin, has recently published a paper on the "combination of hydrated sulphuric acid with nitric oxide. The object of the paper is to show that the impurity in the sulphuric acid of this country, which has hitherto been considered to be nitric acid, is not nitric acid, but a combination of sulphuric acid and nitric oxide. He also shows that this compound of sulphuric acid and nitric oxide, is identical with the white crystalline formed in the vitriol chamber. There are some facts mentioned in this important paper which deserve attention; and it is more particularly the object of these remarks to bring them under the notice of those members of the Association who may be interested in the manufacture of this important acid. It is well known that, in the making of sulphuric acid, when the acid in the chamber reaches the specific gravity of 1.450, it is impossible to go beyond this point without increasing the proportion of nitre; and even with an increased proportion of nitre, the product of acid is less than it ought to be. The reason is, that sulphuric acid, of the specific gravity of 1.450, acts very slowly in decomposing the white compound; and acid of the specific gravity of 1.500, will not act upon it at all, but, on the contrary, it has a tendency to dissolve and retain it.

Mr. Blyth demonstrated these facts by experiments.

M. Adolph Rose states that when sulphuric acid, containing the compound, is concentrated by distillation, at one part of the process pure acid comes over; and when the acid in the retort has reached the specific gravity of 1.84, it will be found, if examined, to contain nitric oxide. It follows from this, that when sulphuric acid is raised in the chamber above the specific gravity of 1.500, it will be found, after being rectified, more or less contaminated with the nitrous compound. He made a number of trials, to ascertain the effect of the nitrous compound upon indigo. Some of the compound was dissolved, by the aid of heat, in sulphuric acid of specific gravity of 1.600. To this solution he added some drops of a strong solution of indigo in pure rectified sulphuric acid. The blue color of the indigo was immediately destroyed. M. Adolph Rose also states, that, if rectified sulphuric acid, which is contaminated either with nitric acid or nitric oxide, be diluted with twice its bulk of water, and concentrated by distillation till it reaches the specific gravity of 1.84, the concentrated acid will be found to have been freed from both of these compounds. It follows, from this experiment, that in order to obtain sulphuric acid sufficiently pure to be used in the preparation of sulphate of indigo, it would only be necessary to draw the acid from the chamber at a low specific gravity, not higher, perhaps, than 1.300 or 1.350. Rectified sulphuric acid, prepared from acid drawn from the chambers at the above strength, if found to be perfectly free from all nitrogeneous compounds, will be a great acquisition to the woollen dyer in the preparation of his sulphate of indigo; and when we consider the large quantities of acid used for this purpose, it will be admitted to be a subject of great importance. Lond. Athenæum.

Carpet Tapestry.

Professor Vignoles exhibited specimens of newly invented carpet tapestry, at a meeting of the British Association for the Advancement of Science, and he explained that these works were made on the principle of the ancient mosaics, being composed of innumerable transverse sections of woollen threads. No painting, no coloring, was used; all the effect was produced by ends of worsted about one-eighth of an inch long, standing vertically, one end being seen, and the other cemented by India rubber to a cloth. The exact operation was yet a secret, but he believed that two frames of fine wire, or perforated zinc, (some with even 4,000 perforations in an inch,) were placed over each other, exactly vertically, the distance being only regulated by the height of the room, in the present instance he believed about five feet. The picture to be copied being then traced on the top side of the upper frame, a workman passed threads of dyed wool through the corresponding holes in the top and bottom frames, of course, as in tapestry, varying his shades and colors until he is satisfied with the effect; this he can judge of by looking down on the upper ends of the threads, although to a person looking at the space between the frames, there seems only a confused and compact mass of worsted. When the workman is satisfied, the upper ends of the threads are covered with India rubber cement, and a cloth is laid upon them also covered with cement; the ends of the threads firmly adhere to this cloth. By means of a sharp cutting instrument, the entire mass of threads is now cut through transversely, at about one-eighth of an inch from the cloth, and this process being repeated, a fresh copy is obtained from every one-eighth of an inch. In the present frames, being five feet apart, 480 copies can be cut, and as there is no limit to the distance, except in the height of the apartment, thousands of copies may be taken of each. Were this not the case, the invention, however ingenious, would be too expensive to be purchased, except in solitary instances as specimens of curious art; but, from the facility of reproduction, this fabric was likely to come into general use for carpets, rugs, curtains, table and chair covers, &c.; for carpets and rugs it could be made with a longer nap, so as to give any degree of substance.

Ibid.

On the Improvement of the Telescope.

At the twelfth meeting of the British Association for the Advancement of Science, Mr. Fox Talbot said, that this subject occurred to him about two years ago, when the Earl of Ross (then Lord Oxmantoun) was making much larger specula for reflecting telescopes than had ever been obtained before; and he thought, if once we had a very large and perfect speculum, it might be possible to multiply copies of it by galvanic means. He had observed, that if an electrotype cast were taken from a perfectly polished surface, the cast was also perfectly polished; so that no defect of form from this cause could have an injurious effect on the speculum. The great and obvious defect was, that electrotypes were in copper, which reflected but little light. He mentioned these ideas to Professor Wheatstone, who said the same had occurred to him, and he showed him a paper which he had drawn up some months before, and in which he suggested the taking of the galvano-plastic casts of specula in platina, palladium, silver, or nickel, and for especial purposes gilding the copper; taking care that the two precipitations adhered well to each other. So that (said Mr. Talbot) the idea had suggested itself independently to both of them; but, on comparing notes, they found differences. Though it had occurred to him (Mr. Talbot) to precipitate white metals, yet he did not think that platina would have a sufficiently beautiful white metallic polish. Professor Wheatstone had, however, made choice of platina, and, varying the quantity till he found the required proportion, he obtained a mirror in platina, which appeared to him (Mr. Talbot) to have quite brilliant polish enough, and to be white enough to answer the purpose; and he considered, therefore, that Professor Wheatstone had proved, that, at least in one form, the specula of telescopes might be made by voltaic precipitation. His own idea was, that it might be possible to whiten the surface of the copper without injuring the form; and, therefore, having obtained a speculum in very bright polished copper, he (Mr. Talbot) whitened it, and transformed it into sulphuret of copper, and after having retained it about a year, he did not perceive the smallest alteration in any respect. This, therefore, appeared to him a mode by which important results for astronomers could be obtained. For the last year, perhaps, nothing further had been done, either by Professor Wheatstone or himself; but, the other day, being at Munich, he (Mr. Talbot) visited Professor Steinheil, who showed him his inventions, and told him he had discovered a method of making specula by the electrotype. It so happened, that both Professor Steinheil and himself had published their respective methods about a month or six weeks before, the Professor having read a communication on the subject before the Academy of Science at Munich, and printed it, and he (Mr. Talbot) having published his in England. Their modes were, however, different, as Professor Steinheil precipitated gold on the speculum of copper; and having precipitated a certain thickness of gold, he then precipitated copper on the back of the gold, to give it sufficient thickness. He (Mr. Talbot) should have thought beforehand that gold would not reflect light enough to be available; but Professor Steinheil informed him he had found, by careful experiment, that it reflected more light than polished steel. He allowed Mr. Talbot to look through a Gregorian reflecting telescope, of which the speculum was a common one, but gilded, and he found the image perfectly clear and well defined. A slight tinge of yellow was thrown over all the objects, but the image was perfectly clear and defined.

Professor Steinheil said, that in the course of a year he should have a very large telescope, furnished not only with a speculum, but also with other apparatus, voltaically formed, so that telescopes might be made all from a good model, so as to insure greater accuracy of proportions; and in this way even very large telescopes might be constructed, at a comparatively trifling expense. With reference to precipitating copper on the back of the gold, the Professor had a simple expedient for securing adhesion. He first precipitated gold from the cyanide of gold, and he mixed with it cyanide of copper, and kept gradually increasing the quantity of the latter sort, so that an alloy was precipitated, which was continually increasing the copper with respect to the gold, till he had a speculum whose surface was gold, and which then became an alloy, the quality decreasing, till, at the bottom, it became pure copper. This was important, because without such experiments, one would not have known that such results would have followed, for some philosophers supposed that if we attempt to precipitate the salts of two metals, only one was precipitated; but Professor Steinheil informed him that they precipitated in union. He thus obtained a speculum with a face of gold and a back of copper. Ibid.

On the Nature of Iron.

Mr. Nasmyth brought forward, at a meeting of the British Association for the Advancement of Science, several specimens to illustrate the remarks which he intended to make, in further illustration of former observations. From late accidents, arising from the breaking of axles, the public were alive to the subject, and it was desirable that the question should be examined. In locomotive engines, the axle was the chief point of danger, and it was, therefore, important, both as a scientific and practical question, to determine the nature and habitude of iron when placed under the circumstances of a locomotive axle. Experiment was the only way to discover this, and he would have wished to place iron under exactly similar circumstances, but the short time intervening since his last observations, had rendered it impossible to do so. One opinion at that time was, that the alternate strains in opposite directions, which the axles were exposed to, rendered the iron brittle, from the sliding of the particles over each other.

To illustrate this, Mr. Nasmyth took a piece of iron wire, and bent it back and forward; it broke in six bends. He had suggested annealing as a remedy for this defect—in proof whereof, he took a piece of annealed wire, which bore eighteen bends, showing an improvement of three to one in favor of annealing. He should, therefore, advise railway companies to include in their specification that axles should be annealed; he did not like the custom of oppressing engineers with useless minutiæ in specifications, but this was so useful and so cheap, that he considered it ought to be insisted on. To exhibit on a larger scale the effect produced on iron in our workshops, he showed a specimen of iron as it came from the merchant; being nicked with a chisel, it broke in four blows with a sledge, at the temperature of 60 degrees, with a crystalline fracture; by raising the temperature 40 degrees higher it bore twenty blows, and broke with the fibrous or ligneous fracture; so that the quality of iron was not the only circumstance to be considered as influencing the fracture. I noticed, also, (said Mr. Nasmyth) the injurious effect of cold swaging, as causing a change in the nature and fracture of the iron; and here let us take the practical workshop view of the case, and not run after the *ignis fatuus* of electricity or galvanism, but consider the practical effects. Swaging was necessary in many cases, for instance, when an axle had collars welded on, these could not be finished with the hammer, and certain tools called swages were used, from the action of which, great condensation of the iron took place, and a beautiful polish was given to the surface, with what injurious effect he would show by the next specimen, which had been heated red hot, and then swaged till cold; it broke at one blow, without nicking, and the fracture was very close and beautiful, like steel. This showed the fallacy of considering close fine grain a good test of excellence in wrought iron, but moderate swaging was often necessary, and not injurious, unless where an over regard to finish carried it to excess. To prove that annealing restored the toughness and fibrous texture, a portion of the last bar was heated, and cold-swaged till cold as before; then heated dull red, and left to cool gradually. It bore 105 blows without breaking, and at last was rather torn asunder than broken, as was shown by the specimen. This proved that the fibrous structure was restored by annealing, and he, therefore, thought it should be insisted on in specifications. The effect of heating to welding-heat was very injurious, unless the iron was subsequently hammered to close the texture. A piece of the same iron, heated to welding, and left to cool, broke without nicking, in one blow, showing very large crystals, especially in the centre. The effect of nicking was also very singular. The strength of iron was generally stated to be equal to its sectional area; but a nick not removing $\frac{1}{100}$ of the area, took away $\frac{1}{10}$ of the strength. Mr. Nasmyth broke a piece of nicked, or rather scratched, wire, to illustrate this point. These, and similar things, did not prove that science and practice were at issue; but, as Halley reached the great accuracy of his prediction of the return of his comet by taking into account the disturbing forces of Jupiter and Saturn, and the other planets amongst which the body had to pass, so scientific men should seek in the workshops correctional formulæ, by learning there the practical occurrences which would elucidate their theories, and he hoped that these specimens might be of some use. Ibid.

Living under Water without communication with the Atmosphere. Dr. Payerne's Experiments.

One of the most remarkable experiments of modern times, was performed last week by a Dr. Payerne, at that excellent experimental school, the Polytechnic Institute, Regent street. Dr. P. descended in the great diving bell of that establishment, in his ordinary dress, and remained there for the space of three hours without any communication whatever with the upper air, and apparently without having been in the slightest degree affected or inconvenienced by his long submersion. He states that he could just as easily have remained down twelve or twenty-four hours; indeed he assigns no limit to his powers of subaqueous vitality. General Pasley, and several other eminent scientific individuals kept watch at the bell during the whole of the three hours, and were perfectly satisfied that no supply of vital air was conveyed to Dr. Payerne from above.

Now that this surprising feat, so long regarded as of the class of physical impossibilities has been at last accomplished, every one (as usual) is discovering how easy it is. It is only to take down with you something that will absorb the carbonic acid gas as fast as you generate it, and something else (with a lucifer match or two to heat it) from which you may get free oxygen enough to keep you alive. Doubtless these are the main conditions of the experiment—and there are several well known substances which do possess these two requisites. Pure potassa, for example, will absorb nearly half its weight of carbonic acid gas; and chlorate of potass gives out, when heated, 3915 parts per 100 of oxygen.

Dr. Payerne is said to be now engaged in constructing a subaqueous boat in which he will undertake to enter any enemy's harbour unseen, and in a single day apply the means of destruction to every ship it contains. Mech. Mag., May, 1842.

India Rubber Stoppers for Bottles.

At a meeting of the British Association for the Advancement of Science, Mr. Brockedon exhibited specimens of his patent India rubber stoppers for bottles, explaining the late improvements in the construction of the cores on which the India rubber is spread. The present cores, he said, were made of cotton twisted into strands, &c., by means of a machine which he explained by a diagram. The cylindrical rope now consisted of several strands of tightly twisted cotton, lapped with flax thread, and laid together longitudinally, loose fine cotton rovings being placed between them; the entire was then lapped in a cylindrical form with flax thread, attaining by this method the advantages of perfect roundness and firmness. They also gave sufficient hold to the corkscrew, and bore the heating process well. These stoppers would slide on glass when wet, but not when dry (although there was no cohesion in this latter state,) so that the bottler, by slightly wetting these stoppers with the liquor which he was bottling, could easily insert them; and when this slight film of moisture was dried up, the stopper required considerable force to withdraw it.

Lond. Athenæum.

On Painting Timber.

We extract the following observations on painting timber when exposed to damp, by Mr. Lander, from the Professional Papers of the Royal Engineers.

I beg to lay before you a few observations which I have made on the construction and causes of decay in bridges, on the works at Devenport, having been employed on the erection of the bridge at the north-west barrier, in the years 1812 and 1813, and also on a large repair in 1837; and I am now employed on a similar repair at the north-east barrier bridge, which, I think, was built in 1816, which has induced me to make the following remarks:

1st. These bridges were paved with Guernsey pebbles, which, I think, was one cause of decay, as the wet constantly dripped through the joints, an evil which may be avoided by Macadamizing, by which such a compact body is formed that the wet cannot get through, and the joists and girders, &c., are thereby kept perfectly dry, besides the advantage of the vibration being very much reduced, as is the case now at the north-west barrier.

2nd. The wood work below, as well as the under side of the flooring, was frequently payed over with coal tar, which, forming a thick body on the surface, was another, if not the greater, cause of decay, as it completely prevented the air from acting on the wood, thereby keeping all moisture within, which of itself is sufficient to decay it. It must be observed that the plank, or flooring, was so rotten, that in many places it would not bear the weight of the workmen, and many of the joists and girders broke into pieces in removing them; some of them were found to be quite dry, and in a similar state to snuff.

3rd. As a further proof of the bad effects of the paying and paving bridges, I may state that the bridge at the south-east barrier across the old works leading to Stonehouse, the girders, joists, &c., of which have never been payed or painted, and the road above always Macadamized, remains sound and good at this time; and I know this to be a much older bridge than either of the former.

4th. I should state that the timber alluded to above is oak, but I think the same observations will apply to other timber, and in other situations, such as fences, for many posts and rails of the stockade fence here have frequently been found decayed, while in other and older fences, although much worn by time, yet not having been payed or painted, the fibre of the wood remains in a healthy state.

5th. I am also of opinion that skirting to walls, and linings to storehouses and other buildings, if not painted would last much longer, as the damp from behind would then be allowed to evaporate by the action of the external air.

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Cost of Transportation on Railroads. By C. Ellet, Jr., C. E.

[CONTINUED FROM PAGE 304.]

On the Value of Time.

In estimating the cost of transportation on railroads I have taken no account, in the preceding numbers, of an item which is generally considered of great consequence in determining the result; viz. *the value of time.* Speed is the peculiar advantage of railroads, and one which is certainly sometimes deserving of much consideration in the administration of the work. I propose to estimate its real value, as nearly as it can be done, in the transportation of passengers and merchandize.

First, then, what are we to regard as the measure of the value of time on any article of merchandize? Is it not the interest on the capital invested in the commodity, at the rate at which the proprietor estimates his profits for the time, added to the rate at which his goods depreciate in value in consequence of detention on the route?

If this be true—and I cannot well perceive what other value than this the *time* lost in their conveyance can possess—let us endeavour to ascertain to what it will amount under different circumstances; and for this purpose we will represent by

r the rate of interest, and depreciation of the value of the goods, per cent. per annum;

P the value in dollars of one ton of the commodity; and

V any velocity of transportation in miles per hour.

There are 8760 hours in a year; and if we represent this number by m, the interest and depreciation of the value of a ton of goods, in the space of one hour, will be expressed by

$$\frac{\mathrm{P}\,r}{100\,m};$$

and during the time the goods are carried one mile at the velocity V, it will amount to the sum

$$\frac{\mathrm{P}\,r}{100\,m\,\mathrm{V}}.$$

This interest and depreciation, for any other greater velocity V'. will be for the time consumed in traversing one mile

$$\frac{\mathrm{P}\,r}{100\,m\,\mathrm{V}'};$$

and, consequently, the difference between the values of the two velocities V and V' (supposing that the time and speed be well employed, and that the engine drivers do not waste at the stations and depots what he gains on the route,) for each ton and for one mile, will be

$$\frac{\mathrm{P}\,r}{100\,m}\left(\frac{\mathrm{V}'-\mathrm{V}}{\mathrm{V}'\,\mathrm{V}}\right). \qquad (\mathrm{K})$$

This expression represents the amount which the goods would depreciate while passing over one mile, at the velocity V, over and above their interest and depreciation while traversing the same distance at the velocity V'; or the additional sum which the owner of the goods would be willing to pay to have them carried at the speed V' instead of the slower rate V.

Now let us apply this equation to the transportation of coal, and assume for the velocity V' that which would be likely to have place on a railroad, or ten miles per hour; and for that of V the ordinary speed of a canal boat, or two and a half miles per hour; for the value of the commodity, *three dollars* per ton, and for the value of the capital employed in the trade, 20 per cent. per annum.

How much per ton per mile would the value of a speed of ten miles per hour exceed that of two and a half miles? By the equation we have here

$$\frac{3\times 20}{8760\times 100}\left(\frac{10-2.5}{10\times 2.5}\right)=\frac{1}{48666}\text{ of a dollar,}$$

or a frcation more than the fiftieth part of one mill per ton per mile.

It would appear, then, if this process be correct, that there is but little encouragement to tear the road, and cars, and engines to pieces—augment the risk of accident, and increase the actual cost of transportation 100 per cent.—for the purpose of delivering coal a few hours sooner than it might be effected on a canal at a speed of two and a half miles per hour. If the value of the coal be not more than three dollars per ton at the mine, and the value of the capital engaged in the trade not more than 20 per cent. per annum, the difference to the proprietor could not amount to more than the *fifth part of one cent per ton for the whole time consumed in traversing a space of* 100 *miles.*

Again, let us suppose that the article is flour, of which the value is six dollars per barrel; and let us, at the same time, assume that the depreciation would be 100 per cent. per annum; which is equivalent to the supposition that it would be entirely destroyed if it were detained one year on the passage, and that the depreciation is uniform during the whole period. We will also suppose that the speed on the railroad is infinitely great, or that a mile might be passed by a locomotive engine in a space of time so short as to be wholly inappreciable; while the speed with which the same article would be transported on a canal is, as usual, two and a half miles per hour.

What is the value of the time lost on the canal in this case? Here we have $r = 100$, $P = 6$, $V' =$ infinite, and $V = 2\frac{1}{2}$; which quantities being substituted in the equation yield

$$\frac{100 \times 6}{8760 \times 100} \cdot \frac{1}{2\frac{1}{2}} = \frac{1}{3650} \text{ of a dollar,}$$

or about the *fourth part of one mill per mile per barrel.*

This will be recognized as rather an extreme case; but still it does not justify a high speed,—for three mills per ton per mile is generally not very perceptible among the quantities which enter into the aggregate expenses of a railroad line.

Let us next suppose the commodity to be groceries—such, for instance, as sugar and coffee—of which the value may be assumed at two hundred dollars per ton; and that the interest and depreciation are equal to 20 per cent. per annum. In this case we will find for the difference between the value of a speed of ten miles per hour, and one of two and a half miles per hour—between the speed of a locomotive and that of a canal boat,

$$\frac{200 \times 20}{8760 \times 100}\left(\frac{10 - 2\frac{1}{2}}{10 \times 2\frac{1}{2}}\right) = \frac{1}{730} \text{ of a dollar,}$$

or about *one and a third mills per ton per mile.* The difference between the value of a speed of five and one of ten miles per hour, would not in this case have exceeded a half mill per ton per mile.

A high speed, then, is not justifiable in the transportation of groceries for the purpose of saving time in the delivery of the freight. If it be adopted at all it must be because the condition of the road, or some other part of the business which it accommodates, renders it imperative, or because the injury which the work sustains in consequence of the greater velocity is not properly appreciated by the parties in control of the line.

We will next take the case of dry goods, of which the average value may, perhaps, be assumed at 2,000 dollars per ton; the interest and depreciation will again be put at 20 per cent., and the respective velocities at two and a half and fifteen miles per hour.

By the formula we have, in this case,

$$\frac{2000 \times 20}{8760 \times 100}\left(\frac{15 - 2\frac{1}{2}}{15 \times 2\frac{1}{2}}\right) = \frac{1}{66} \text{ of a dollar,}$$

or one cent and a half per ton per mile.

This sum is nearly equal to the actual cost of transportation on a road in good condition; and it is therefore apparent that in the conveyance of trains composed exclusively of the most valuable goods, a greater velocity than two and a half miles per hour is always proper; but when it is recollected that there is never more than a very small proportion of the merchandize passing over a line, which possesses anything like the value here assumed—2,000 dollars per ton—the adoption of a higher velocity must still be regarded as of very doubtful utility. Even in the case before us—where the value of the goods is assumed at 2,000 dollars per ton—the difference between the value of a speed of fifteen miles per hour and one of six miles per hour, would not amount to a half cent per ton per mile—a sum which would by no means justify a high speed even if the train were loaded entirely with such goods.

If we apply the same method of computation to the conveyance of passengers, and estimate the average value of the time of all the individuals in the trains, at twelve cents per hour, we shall have for the difference between the value of a speed of fifteen miles per hour and the usual speed of freight boats on canals, or two and a half miles per hour,

$$12\left(\frac{15 - 2\frac{1}{2}}{15 \times 2\frac{1}{2}}\right) = 4 \textit{ cents per passenger per mile.}$$

If the average time of all the individuals traveling be worth twelve cents per hour, the charges on a road where a speed of fifteen miles per hour is adopted, *may be four cents per mile higher than could be demanded on one where a velocity of only two and a half miles per hour is maintained.* Of course there is a great difference between the values put on their time by different individuals; and of course too, there must be much uncertainty in fixing upon a general average. But twelve cents per hour (including the expenses incident to the trip) is by no means a high estimate for the time of all the individuals traveling in the public conveyances; but yet, low as it is, it shows for the value of the time of one person—exclusive of what mere impatience would prompt him to pay—a sum nearly two thousand times greater than that of a ton of coal, thirty times greater than that of a hogshead of sugar, and nearly three times that of a ton of ordinary dry goods, transported at the same rate.

We may perceive, then, why the superiority of railroads is so much greater in the transportation of passengers than of heavy freight; and how it may happen that a velocity which is in the highest degree economical when adopted for the convenience of travelers, may be ruinous when applied to the transportation of minerals and produce. Indeed it is difficult to over-estimate the injury which is inflicted on the interests of stockholders, from the continuance of this evil in the management of railroads, although it has been materially abated within the last four years. The value of the additional time which is consumed at the slower rate is absolutely unworthy of consideration in the conveyance of merchandize; and the only question which ought to occupy the attention of the directory is the reduction of the actual expenses of the line, and the selection of that velocity which corresponds with the greatest possible economy. The great and constant effort should be to reduce the cost of transportation to the lowest limit. It is not railroads nor canals that increase the trade of a country or add wealth to the districts which they traverse. It is the reduction of the charges for conveyance which these improvements permit, from which these great advantages are derived. And high speed on such commodities offers no compensation for the high charges which it exacts.

These considerations are applicable only to the value of time on the goods transported. But the loss of interest, and depreciation of the value of the freight, are not the only losses involved in the adoption of an insufficient speed. The value of the time of the *train, and of the train hands,* is also to be considered, and enters into the complete expression of the actual cost of transportation. If the engines and cars, and the men who conduct them, do less duty than they might accomplish by the adoption of a higher velocity, the value of the time of the increase of stock and force which will be required to effect the same duty at the slower rate, must obviously be charged against that velocity.

It is true that there are cases in which the speed to be adopted is governed by the necessity of accommodating a certain amount of trade, or making room for a large passenger conveyance, which could not be adequately provided for on a single track, without maintaining a speed determined by the circumstances. Of course the company must submit to this necessity; they must adopt a high velocity where these or other imperative conditions exact it. But the question now is, what is the value of velocity or time, where they have the power to exercise their own discretion in the selection of the speed?

In all such cases the slower the motion of the train the less will be the expenses of the company, unless it be reduced so low that the interest on the cars and engines which convey the freight, and the loss of the time of the engine and train hands, more than compensates for the reduced charges for repairs of the road and machinery.

We will designate by F the value of the locomotive engine in dollars; by f the value of the stock in cars for each ton of freight; by m' the value of the time of all the hands in the train for one hour; and by q the number of tons of merchandize in the train.

The value of one hour for the whole train will be, at 6 per cent.

$$\frac{6}{100\,m}(F + fq) + m'; \qquad (L)$$

and if we represent this quantity by H, the difference between the values of the velocity V′ and that of V, will be for each ton, and for one mile

$$\frac{H}{q}\left(\frac{V' - V}{V'V}\right). \qquad (M)$$

This is the difference per ton per mile to the company between the values of these velocities, where no imperative conditions obtain.

Now let us see what value this expression exhibits under different circumstances; and for this purpose we will put $F = 5000$; $f = 100$; $q = 50$; $m = 8760$; $m' = \frac{1}{5}$, all which are very common values, and suppose, in the first instance, that the business of the line may be transacted by an adequate supply of engines, men and cars, at some exceedingly slow rate—as half a mile per hour—how much more would it cost the company, in the value of time, to carry the trade at this rate, than at a speed of ten miles per hour?

Equation (L) gives us

$$H = \frac{11}{40} \text{ of a dollar,}$$

for the value of one hour of the time of the train. This value of H being substituted in equation (M) will yield,

$$\frac{11}{40 \times 50} \cdot \frac{10 - \frac{1}{2}}{10 \times \frac{1}{2}} = \frac{209}{20000} \text{ of a dollar,}$$

or more than one cent per ton per mile.

Now, in this case, the value of the time of the train, exclusive of the goods, is equal to half the actual cost of transportation on a well managed road with ample trade; and it is perfectly apparent that, even overlooking the loss of time and depreciation of the price of the *goods,* such a rate is wholly inadmissible. But let us apply the equation to the determination of the difference of value of a speed of five miles and one of ten miles per hour, under the same circumstances. In this case equation (M) gives us

$$\frac{11}{40 \times 50} \cdot \frac{10 - 5}{10 \times 5} = \frac{11}{20000} \text{ of a dollar,}$$

or only one half mill per ton per mile—or less than the tythe of the actual difference of cost—consequent on the destruction of cars, engines and track—risk of accident and damage to goods, incident to the adoption of the greater velocity.

The whole difference between the value of a speed of five miles per hour and one of ten miles per hour, will rarely exceed one mill per ton per mile, in its effect on the interest of the value of the train, together with the depreciation of the value of the goods conveyed. However great, then, may be the inducement to carry passengers at a more rapid rate, there is no sufficient cause for transporting freight at a speed of more than five miles per hour, unless, as already premised, a higher rate is absolutely essential for the accommodation of all the trade which is commanded by the line—a condition which, on ordinary roads in this country, very rarely prevails.

We are not likely to overrate the injurious effect, or too strongly to deprecate the continuance, of the mischievous practice which still prevails in this country in the transportation of heavy commodities. The iron rails are rapidly destroyed by it; the wear and tear of the cars and engines are greatly augmented, and the useful effect of the power applied is materially reduced. There is no corresponding advantage obtained. The value of the time which is saved is almost too small to be estimated for the freight, and the value of the time lost by the train bears no perceptible proportion to the injury which is done to the road and its furniture.

TO BE CONTINUED.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Railways in Massachusetts. *By* ALEXANDER EVANS, *C. E.*

As the great system of railways in the state of Massachusetts is far advanced towards completion, we are not only gratified with the results of her enterprize, but we look to her for much useful and interesting information, derived from actual experience in the construction and working of her roads.

The following tables exhibit the length, the cost of construction, the cost of repairs and working, the receipt from passengers, freight, &c., and the net proceeds of the principal railroads in Massachusetts during the year 1841.

Table No. 1, exhibits the total number of miles run on eight of these roads, and the cost of running per mile; the cost of repairs of engines and cars, per mile run, and the cost of repairs of road per mile.

The cost of running includes all repairs to engines, cars, and superintendence, and all other expenses properly chargeable to the working of the road.

The cost of running trains on these roads varies from 65 to 107 cents per mile, the lowest being the Western road, and the highest the Boston and Providence, and Taunton branch, which cost the same.

It will be observed that the cost of running on the Boston and Providence road is 107 cents per mile, while that of the Boston and Worcester road, which is nearly of the same length, is about 88 cents; but the distance run on the latter exceeds that of the former, by nearly 67,000 miles.

The number of miles run on the Boston and Worcester road is given in the last annual report of that company, for eleven months only of the past year, or up to the 30th of November; but an approximate estimate of the number of miles run in the month of December, has been made from the income of that month compared with the income and number of miles run in the eleven previous months.

The total number of miles run on this road (adding for the month of December, as above,) from 1836 to 1841, inclusive—six years—is 785,427, and the total cost of running was $ 703,930, or about 90 cents per mile.

The cost of running on the Western road has been, for the last year, $65\frac{4}{10}$ cents per mile, and for the six months preceding, it was only $61\frac{19}{100}$ cents per mile.

The number of miles run on the Eastern road during the past year, was 191,209, and cost nearly 81 cents per mile.

Bringing the number of miles run on all these roads together, we find the total to be, for the last year, 850,251 miles, and the total cost of running the same, $ 717,587 dollars, or $84\frac{4}{10}$ cents per mile.

The cost of repairs of cars and engines, per mile run, ranges from 9 to 18 cents.

The cost of these repairs on the Lowell road, the past year, is 18 cents per mile; the excess over other roads may, probably, be in part attributed to casualties and extraordinary repairs.

The repairs for four years, from 1837 to 1840, inclusive, on this road, average $ 14,604 per annum; and for 1841 the amount was $ 22,644, showing an increase of 55 per cent.

By a reference to the annual reports of this company, there appears to have been a great increase of business the last year, and, probably, a much greater number of miles run on the road than any previous year.

The total number of miles run on all these roads, as before stated, is 850,251, and the total cost of repairs of engines and cars, is $ 109,620, or nearly 13 cents per mile.

The cost of road repairs during the last year, for four of these roads, doing a large business, and which have been in operation several years, averages about $ 650 per mile.

On two of these, viz:—the Boston and Worcester, and Lowell, roads, a light rail was used in the original construction, the former weighing 38½ lbs., and the latter 36 lbs. per yard.

Experience has shown that these rails are too light for the heavy traffic of these roads, and the tracks are, consequently, defective, and expensive to keep in adjustment.

In the construction of a second track for these roads, a heavier rail has been adopted, and other improvements made which will, it is believed, considerably reduce the cost of repairs.

On the Boston and Worcester road, there were, at the close of the last year, 70 miles of double track, and the Lowell road has two tracks complete.

The average annual repairs of the Boston and Worcester, Boston and Providence, and the Eastern and Lowell roads, from 1837 to 1841, do not vary much from $ 500 per mile.

The repairs of the Taunton Branch, the New Bedford and Taunton, and Nashua and Lowell, Railroads, average nearly $200 per mile per annum, since they were opened for business.

In Table No. 2 will be found the length, total expenditure for construction, receipts for passengers, freight, &c., and the expenses and net income of ten roads in Massachusetts.

The cost of these roads includes outfit, buildings, and fixtures, or the total amount charged to construction up to the close of 1841.

It is proper to remark, that a part of the expenditure of several of these roads, during the past year, is not strictly chargeable to the cost of operating them, but would with more propriety be placed to the account of construction and outfit.

These, in several instances, are large sums, and being paid out, or deducted from the earnings of the road, considerably reduce the net income.

Eight of the roads embraced in table No. 2, which cost an aggregate of over nine millions of dollars, pay seven per cent. on the capital invested, and the net receipts of several are from seven to nine per cent. on the cost.

The total cost of all these roads is over seventeen millions of dollars; a considerable portion of some of them, however, are not within the bounds of the state of Massachusetts.

The length of the Norwich and Worcester road is nearly sixty miles, eighteen miles of which are in Massachusetts, and the remainder in Connecticut. Nine miles of the Nashua and Lowell, thirty-eight miles of the Eastern, and twenty miles of the Boston and Portland, roads, are in Massachusetts, and the remainder in the states of New Hampshire and Maine.

Statement of the length, cost of construction, number of miles run, and the cost of repairs, of eight Railroads in Massachusetts, for 1841.

No. 1.

Name of Road.	Length in miles	Average cost per mile.	Weight of rail per yard, in lbs.	Miles run during 1841.	Cost of running, per mile.	Cost of repairs of cars and engines per mile run.	Cost of repairs of road, per mile.
					$ cts.	cts.	$
Bost'n & Worcest'r	$44\frac{1}{2}$	53,360	$38\frac{1}{2}$ & 60	174,632	$0.87\frac{67}{100}$	[*] $14\frac{50}{100}$	714
Boston and Lowell	$25\frac{3}{4}$	71,258	36 & 56	125,296	[†] $0.83\frac{66}{100}$	$18\frac{072}{1000}$	720
Bost. & Providence	$41\frac{17}{100}$	43,284	55	107,638	$1.07\frac{8}{10}$	$11\frac{818}{1000}$	594
Western	117	44,744	$56\frac{1}{2}$	160,106	$0.65\frac{4}{10}$	$10\frac{604}{1000}$	
Eastern	56[‡]	40,482	$46\frac{1}{2}$	191,209	$0.81\frac{04}{100}$	$9\frac{32}{100}$	551
Nashua & Lowell	$14\frac{1}{2}$	26,207	57	43,515	$0.87\frac{7}{10}$	$18\frac{988}{1000}$	190
N. Bed. & Taunton	20	21 137	58	27,039	$0.82\frac{4}{10}$	$13\frac{513}{1000}$	170
Taunton Branch	11	22,727	58	20,816	$1.07\frac{8}{10}$	$10\frac{82}{100}$	171

[*] This includes an expenditure of $9,900 for new cars.

[†] This does not include $14,438 expended in taking up seven miles of track of light (36 lbs.) rail, and replacing it with heavy (56 lbs) rail.

[‡] This distance includes Marble Head Branch.

Statement of the receipts, expenses, and net income, of ten Railroads in Massachusetts, for 1841.—No. 2.

Name of Road.	Length of road.	Cost of construction.	Receipts for passengers.	Receipts for freight, mail, &c.	Total receipts.	Expenses of Road.	Net income.
Boston and Worcester	$44\frac{1}{2}$	2,374,547	190,097	120,710	310,807	162,998	147,809
Boston and Lowell	$25\frac{3}{4}$	1,834,893	145,953	121,588	267,541	119,469	148,072
Boston & Providence	$41\frac{17}{100}$	1,782,000	152,016	78,805	230,821	122,057	108,764
Western	117	5,235,026	113,842	68,467	182,308	104,806	*77,502
Norwich & Worcester	$58\frac{9}{10}$	2,157,037	99,332	55,925	155,261	78,805	76,456
Eastern	56†	2,267,033	257,734	41,840	299,574	154,958	144,616
Nashua and Lowell	$14\frac{1}{2}$	380,000	75,732	56,764	132,496	95,966	36,530
N. Bedford & Taunton	20	422,758	39,469	13,044	52,513	22,285	30,228
Taunton Branch	11	250,000	52,278	24,646	76,925	55,043	21,882
Boston and Portland		553,289	85,928	30,088	116,016	82,021	33,995

* This road was not opened to the state line until October, and to the Albany and West Stockbridge in December, 1841.

† This distance includes Marble Head Branch.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reply to the writer of the Strictures on the Report and Plans of the Engineer of the Albany Aqueducts. By W. McClellen Cushman, C. E.

In his article in the last number of this journal, the writer appears piqued to have his former effusions considered a harmless batch of fallacies, misstatements and suggestions "pregnant" with very little, if any, meaning—and the more so probably to have them *so proven in detail.* This last, however, can scarcely be looked upon in as favorable a light—for there seems another than the apparent object evinced throughout this effort; which it is very obvious was intended *chiefly* to serve for (what in politics I believe is called) a "*white-washing*"—of the errors of judgment, fact, &c., existing in almost every sentence of his first critical production.

After opening with an extract calculated to mislead the reader, from an allusion in my last, the writer complacently proceeds to attribute his *own misconceptions* to "the ambiguity of the style of the report." This would seem, certainly, at the very best, a rather lame *argument* on a scientific subject; and were best answered, perhaps, by inviting the reader to compare the styles of our respective articles, and such extracts from the report as the public have been favoured with (of late particularly) by the critic's liberality. But admitting the argument to have no foundation in the egotism of the writer, I beg to enquire in what way it supports the *errors of fact, judgment, &c., volunteered* (of course unassisted by the report) by the writer and his council of "practical friends," as exhibited, in italics, in my reply?

I. The writer next accuses me of "a design to dispense entirely with fire engines!" I have no disposition to set this down as much of a mistake—but it was with short hose that I proposed to produce jets rising to within ten feet of the fountain level *in the elevated district in which the aqueduct terminates*, at which place the head was stated to be fifty-five feet. I have at no time entertained an expectation of being able to force up jets to the *same actual level above tide*, in the *low districts;* but to heights proportionably near it, having regard to the resistance of the air, &c., in abridging the height of jet;* which, however, it is almost needless to intimate, would always extend to elevations much greater than is strictly required for the successful operation of the jets, for the purposes proposed, *throughout such portions of the city.* All this was distinctly enough stated in my reply; and the experiments on the Croton Aqueduct happening just at that time, were adduced as full confirmations of the views advanced in my report—and especially as regards the jets in the upper quarters, where there must, of course, be the most difficulty. I have now before me the late report of the engineer of that work, in which he states, that the jets at Haarlem river rose to a height of 100 feet, which statement does not differ materially from that made in my letter.

More recently still, as at the late celebration, &c., have former trials been again and again confirmed by experiments at the same places, and even at the fountains in the city of New York, &c. Yet the writer appears to consider the *extended experience*, as regards jets, on that work, as not possessing any claims to confidence, in comparison with the *single trial* at Fairmount, which, as was previously shown, was made in *impracticable circumstances!* With due respect for the reputation of the author he quotes, (though without having had an opportunity of examining the principles of his formula,) I must be permitted to say authority can weigh nothing in the face of the *palpable experience* derived from this series of trials, made in *competent circumstances* and on a grand scale—which give full and repeated assurance of the soundness of the views advanced in my report.

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* "By no manner of contrivance, however, can fluids be made to issue from a pipe, or any other orifice, with the full theoretic velocity due the head of fluid; and the motion of the jet must invariably be still further reduced by the resistance of the atmosphere in its ascent, after issuing from the orifice, or pipe. Both these circumstances modify considerably the height of jet." Report, page 4.

The writer imputes (with a flourish) some fanciful discrepancy between the statements of my letter and those of the report, as regards the level of fountain head, &c., in different parts of the city. Now the level at which the fountain head was established, as explicitly stated in several passages of the report, was 260 feet above tide level; and the same fact is inferable at several other places, by the simple process of *addition;* and this head, or level of head, is of course common to all points within the city limits, to which the water shall be conveyed—and this, although the reservoirs which form the *actual* fountain head, are located at the Cohoes, ten miles from the city. The *effective head* at the city, or that which actuates the flow and determines the specific quantity of water deliverable there, is also very distinctly stated, at several places, to be fifty-five feet, and this of course refers more expressly to the particular point at which the *aqueduct proper* terminates, and delivering over its supplies to the city mains for distribution. These latter being, of course, all in communication with the aqueduct and under the influence of the *common fountain head* will give local jets of heights bearing a relation to the depression of their orifices below its level, &c. Much nicer *visionary faculties* than ordinary men possess were necessary, I think, to discover any thing incongruous between these facts and the statements in my letter—the substance of which was, that in the *low section* of the city (which is elevated but little above tide, and gives, consequently, nearly double the head at Haerlem,) we should be able to perform even much greater things, in the way of jets, than had been done at that place, and we certainly shall do this, notwithstanding "the pregnant meaning" of the "facts" and objections the writer has produced.

Not to cavil about an *actual* difference of fifty per cent. between the writer's present and former statements as to height of jet obtained at Fairmount, I have only to say, it was certainly no concern of mine whether the writer did or did not obtain "such results as might have been expected" *by him;* and it became so at all, only because omitting the essential circumstance of the trial having been made with "a single ajutage of one inch in diameter," he still took upon himself, upon the strength of that "indirect fact," the responsibility of deciding upon the feasibility of my plans for applying the head of water as a power, to the extinguishment of fires; which plan had reference "to an appropriate orifice for the jets," the copiousness of the supply of water, and contains other evidences of *respect for the laws of nature.* How the writer could do this upon the strength of a *single trial* made in *violation* of all these indispensable requirements, unless by mistaking his "stubborn fact" for a "principle"—in other words by evincing that he had no knowledge "of any such requirements," is a question for the candor of the public to decide.

The influence of the ordinary consumption of water upon the head in *standing pipes,* as instanced by the writer at the Navy Yard in Philadelphia, is perhaps one of the peculiar features of the plan on practice in that city. At any rate the essential independence of the jets of this city, is insured by the *location* which I have given the line of the *aqueduct proper within the city limits;* and it does so by determining the order in which the different sections will derive their supplies. It is in this way that the ordinary supplies of the citizens will "go on at all times when it is required," without sensible restraint upon the jets.

I did not propose to rest the safety of the city "upon the possibility of catching fire in its inchoative state," (meaning, it is presumed, when a fire first breaks out.) The writer unwarrantably assumes an intention on my part of dispensing entirely with the use of ordinary hose. Quite the contrary: the system of "short hose attached to the hydrants," forms the means of producing "an almost instantaneous effect," before "ladders, lengthy hose and a competent force to manage them could be provided,"—but which, *on their arrival,* could also be *attached to the hydrants;* and co-operate just as at present; and serve for *casting on water* at all points and in all positions within the reach of moderate jets; and always for *delivering* water at every accessible point, up to the roofs of the most elevated buildings in any quarter of the city. Nor must the system of pipes "for domestic and economic purposes," capable of delivering water into the "highest chambers," and (with the surplus head) even *above* the roofs—be supposed to play an insignificant part in the general plan.

Such is an outline of the system contemplated; which, while it will relieve firemen from the almost super human efforts they are now required to make, *in forcing jets by means of engines*—and often even then without the power of staying the progress of devastation—will at the same time be able to arrest even the most "considerable conflagration effectually and expeditiously,"—even could we suppose such conflagrations either probable or *possible,* with such means and appliances at hand.

The writer feels "impelled to the conclusion" that I *must* have meant to restrict the size of the orifice to one and a quarter inch, &c. Whether the impelling power in this conclusion is or is not attributable to the limited inventive powers of the critic, I leave for others to judge. He is, however, as greatly mistaken in this as in most other "conclusions" of his. It appeared to me a very easy matter to manœuvre short hose of even pretty large calibre, and with orifices as large at least as the body of the common hose; and having satisfied myself from some observation and an attentive examination of the results of Mariotte, and other experimentalists, that *with orifices approaching this size,* it was perfectly practicable, on this general arrangement, to throw up jets of the height contemplated in my report, I left the *exact size* to be determined by trial when the aqueduct should be put down—intending to use just that size which should prove to be just adequate to produce the required effect as local jets, —comparatively small orifices, &c., being practicable in the districts of inferior level, where the *supply* of water, &c., would be greatest.

III. As regards the "fatal doctrine of one-twentieth of an inch," &c., I must request whom it may concern (and every city and flourishing village in the Union is deeply interested in the means of obtaining *abundant supplies of pure and wholesome water,* on an efficient and at the same time economical plan) to recur to my late reply, to perceive at once, and clearly, that the *actual thickness* of metal assigned the conduit, was *more than adequate* to support, *permanently,* the head it will be required to sustain—the conduit at Haerlem river having been actually working, for months, under "less than the equivalent of one-fourth of an inch for a seventeen inch pipe," &c.

The writer, however, disdains to notice the *practice there,* with tubes of twice the size of those at Philadelphia, (thirty-six inches is, I believe, the calibre) and with every thing else on a much greater scale. The reader will look in vain in his last effort for any reply to, or notice of, this *decisive case* of practice—which was adduced in my letter to show the "error" of *judgment* under which he laboured, in regard to the "*real results* of practice," &c.—and this, although he appealed so unreservedly in his first critical essay, *to practice,* as the *only criterion!*

But a grand reason for finally settling upon this thickness in preference to any other, was not from any misgiving as to strength, but that it was conclusively settled, in my mind, that castings of one-twentieth of an inch *could not be executed,* nor indeed of any *less thickness* than the *fourth* of an inch, except by actually enhancing the cost of the work,* which of course left no rational motive for adopting any higher dimensions. I was subsequently fully confirmed in the propriety of this opinion and decision, on consulting with founders of skill and experience—whose opinion on such a point merited every confidence.

On some future occasion I shall, perhaps, find a convenient opportunity to enlarge upon the relations which should subsist between the diameter and thickness of metallic pipes, in order to sustain a determinate pressure, &c., and the writer is assured that I will then find it quite easy to establish the adequacy of the least thickness stated in the report, as regards capacity to sustain a *working head of fifty-five feet;* and, consequently, its suitableness (with some allowance for unavoidable corrosion, &c., before being laid, and, perhaps, in the first stages of the operation of the works) for the purpose, but for the practical difficulty in the way of executing the castings—quite as easy indeed, as *I have been* successful in demonstrating by *practice* that the actual thickness of metal to be put in the conduit, viz. one-fourth of an inch,† is at least *more than is really necessary.*

In the mean time I beg to remind the writer that he has not been "good enough to define what degree of excess of thickness will always make pipes secure when they fail only at imperfections," and will now, if he pleases to accept easier terms, reduce the challenge simply to failure of sound castings.

Regarding "the contingencies from without," and the *theory* of the writer as to the mode in which he deems pipes to be injured by the pressure of the earth which covers them—even admitting that any engineer of sound practical views can be found to concur in this theory, remedies for such contingencies are so easy, in my view, as to make any objection founded thereon quite frivolous.

V. This appears to be nothing more than tautology—a repetition of part of the preceding article.

VII. It would be a sufficient reply to the writer's *theory* as to "the momentum not being kept up while the piston clears the dead points," &c., to remind him that the proportions and play of the pumps, and other members of the elevating machinery, are *all essentially different*—the works at Fairmount not having been taken as my model: and that a Watt, a Smeaton, or a Fulton, would most probably also have presumed so far as to differ with the writer in his *entire admiration* of the plan of the works at Fairmount; and would probably have preferred to draw pretty largely upon the reservoirs of their own genius and skill. But is it not true that the works at Fairmount have several pumps worked by one shaft, and discharging into a common main or force tube? If so, does not such an arrangement *virtually* annul the effect of dead points? The theory of the writer seems to me to *fail* entirely to account for the destructive effects observed by the superintendent of those works.

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* "I do not think, however, that economy would be consulted in reducing the thickness below one-fourth of an inch; although, of course, with this calibre, the pipe would, *as far as strength is required*, bear a reduction of its thickness." Report, page 25.

† "The Philadelphia conduits being two-thirds of an inch thick and the Albany one-fourth of an inch, the quantity of metal in the latter is five-eighths, or 62 per cent., *less;* which prodigious economy of the costly material of which they are made, it will be observed, is *exclusively* the effect of *plan.*

The writer seems not yet to have discovered that *the conclusions* from facts, practice, and experiments, are often very absurd and improper; or that there is a pseudo false philosophy of this description which is an extremely fertile source of "error." In this way has he, I think it probable, mistaken "*theoretical conclusions*" for "experimental results of a very significant character;" and although such results should not perhaps be entirely "disregarded," still *practical men* may I think be permitted, (without incurring the imputation of "not feeling a proper anxiety for the success of works committed to their charge) to credit them only for just what they are worth. *

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In concluding I must take occasion to say that any critical remarks made in my report, were quite general in their character—no particular work being specified; that none were made which could well have been omitted, or which were not absolutely necessary as arguments to show the propriety of the plans I proposed, &c. If, therefore, any thing unkind has been said, or "odious comparisons" made, in regard to the Fairmount works, or the city conduits, or any other work, in the progress of this controversy, the thanks are due exclusively to the writer of the criticism on my report,—who rendered the special allusions necessary for its proper and just vindication.

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* The next paragraph in the MS. of our correspondent, containing personal remarks, which can have no bearing upon the question in controversy, has been omitted. Indeed it is to be regretted that better temper has not been displayed in the whole conduct of the discussion, since both of our correspondents, doubtless, look to the same result—the establishment of what they believe to be truth, and the cause of truth is neither aided by harsh language nor personalities. Com. Pub.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Practical Experiment made by M. Fourneyron, to show the superiority of a Turbine over an Overshot Wheel, both using the same quantity of water, and working under the same fall.

The second turbine which I established was not tried with the friction dynamometer; it was not necessary here to prove to the proprietor for whom it was constructed how much it returned of the power expended, but only to show, that to produce the same effect, it consumed less water than other wheels, and that it turned under water sheltered from the frost,* and was but little affected by variations of level.

For this purpose, the turbine was placed under the same fall that drove an overshot wheel, which had been established some years, and which worked with the required velocity the pistons of the blowing machines of a furnace, which my turbine also was to drive.

One wheel was put into gear, and the other disengaged, while the opening of the sluice gate was regulated so that the expenditure of water should remain the same in both cases.

The overshot wheel was run sufficiently long for its motion to become uniform, and the strokes of the piston were then counted. The turbine was then put into gear, the other being thrown out, and after having run some time, the strokes of the piston furnished by it, were also counted.

The following were the results:

When the blast of wind vented was under 13 or 14 cubic metres (489 to 594 cubic feet) per minute, the two wheels (overshot and turbine) to produce the same effect, consumed the same quantity of power, for the turbine had then a velocity, and a width of gate drawn, which were very small.

On the contrary, in proportion as the opening of the gate and the velocity increased, a greater blast was produced by the turbine than by the overshot wheel, all other things being equal. Finally, when the turbine worked under the influence of the conditions of its establishment, or those for which it was planned, the effect produced notably exceeded that of the overshot wheel with which it was compared, which was in good order and had been well constructed. This overshot wheel, a single arm of which weighs more than the whole of my turbine, (whose weight is only 80 kilogrammes, or about 180 lbs.,) *is not susceptible of producing a power greater than three-fourths of that of this small wheel,* as was ascertained by the maximum blast produced alternately by each.

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* The great ease with which the turbine of M. Fourneyron can be sheltered from the *effects of frost*, will be readily appreciated by all practical men, who have had the management of water wheels in a northern climate, for it is quite evident that either by running the turbine in a close forebay, within the body of the mill, or by immersing it at will to a suitable depth *in backwater*, (as was done by M. Fourneyron, with a fifty horse wheel, at Fraisans, in France,) this peculiar water wheel *may, with ease, be effectually protected from ice.* M.

To show the facility with which it works under water, we immersed it to a depth of $1\cdot\frac{20}{100}$ metres, ($3\cdot\frac{94}{100}$ feet,) when it continued not only to give the necessary blast, but also made the overshot wheel revolve in the backwater. This wheel, though it received no water from above, while the turbine made it turn, yet without load, and whilst receiving all the water it could use, it had difficulty in taking a velocity half as great as that communicated to it by the turbine.

I know that these experiments, if they were isolated, would not be conclusive as to the utility of the machine, but I had to address myself to the eyes of a practical man, who judged better by experiments of this kind than by the use of a friction dynamometer, of which he did not understand the application.

Desiring to demonstrate, by figures, the superiority of the turbine over the wheels usually employed, I proposed to him to submit it to the trial of a brake, before I constructed the larger one, (of 50 horse power, at Fraisans,) which he was about to order; but being satisfied as to the results, after a few months' observation, he no longer delayed to intrust me with the construction of the large turbine which I have recently completed.

Bulletin de la Société d'encouragement pour l' Industrie National.

Franklin Institute.

Address delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842 *; by* A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

The traveler in the deserts of Syria, resting at one of those few favored spots where the turf shows the presence of the refreshing well, and the date palm gives him shade, finds himself amid the ruins of a great city. Broken columns—architraves, and fragments of pediments half imbedded in the sand—heaps of ruins, indicating the former existence of massive structures, and deluding him with the idea that even now he may trace the extent and form of the space once occupied by the dwellings of men—all speak of the magnificence, the grandeur, and the vastness, of a great commercial capital. He is amid the ruins of Tadmor of the wilderness, Palmyra, the great commercial emporium of former days—now part of the greater desert. Here was once the entrepot of the commerce of the East and West, and here arose a city—as it were one vast temple to that commerce which linked together the far East and West.

Amid the lagunes and marshes at the head of the Adriatic, the gorgeous fane and splendid palace are reared, and the varied ornaments of a florid architecture are lavished to decorate the homes of the merchant nobles. The very difficulties of the site are made to contribute to luxury; no noise of wheels disturbs the quiet of home, or the hum of business on the Rialto, but the luxurious gondola glides silently through the vast canals which connect the distant quarters of this queen of the sea. Commerce has been again at her work. Civilization has advanced westward; and while Tadmor is crumbling, and the sands of the desert are gathering over its ruins, Venice is rising from the waters, the new entrepot of commerce between the East and West.

A new route is discovered, by which the products of the agriculture and arts of India are conveyed to Europe; commerce departs with prosperity in her train, and Venice is given over to the destroyer.

In the early periods of history these changes were few, their progress was gradual, like the slow changes of the scenes of a diorama; ages elapsed before the tide ceased to set through Palmyra. In modern times the changes are like those of the kaleidescope, sudden and striking. Agriculture changes its objects or its methods—manufactures spring up and flourish, or decay—the arts find new seats and new subjects for their exercise—commerce, which connects the producer and the consumer, runs in new channels. Cities greater than Tadmor or Venice spring up, the creations of a new civilization.

Increased production, whether in agriculture or manufactures, is so obvious and powerful a source of prosperity to a country, that we naturally look with interest upon every circumstance which may effect it, endeavoring as far as may be, to understand, that we may aid. While all are agreed as to the necessity for cherishing agriculture, manufactures, the mechanic arts, and commerce, as the essential elements of national wealth, few agree as to the means of protection. One would think that by this time facts enough had been accumulated to settle all doubts, and to establish a science whose principles should be as well ascertained as those of the philosophy of nature. But the passions, prejudices, and interests of men must be overcome before they desire to find the truth; and then all the difficulties remain of interpreting the results of complex experiments, and of assigning the just influence to each of their numerous and varied attendant circumstances.

It is conceded in every civilized community that the products of its agriculture, manufactures, and arts, should be brought as nearly as possible to perfection, and that improvement is the necessary consequence of the increased intelligence of those who follow the various callings connected with them. Avoiding, then, debated and debatable ground, and planting ourselves upon that which is fully and fairly our own, it may be profitable for us to consider *the means employed in different countries for the promotion of manufactures and the mechanic arts, and of the intellectual improvement of their cultivators.*

From this general survey, we may derive materials for a comparative estimate of our own efforts—encouragement it may be, or stimulus to increased exertion;—hints of new lines of usefulness, or assurance that perseverance in those in which our efforts are already directed, will ultimately be crowned with success. In a country like this, where public opinion makes, alters, or repeals, the laws, there is always reason to hope for the success of what is right. It may not come this moment, nor the next, but as sure as the darkness of night heralds the approach of dawn, which certifies the coming noonday, so surely will truth finally prevail where public opinionrules.

The principle of voluntary association by which, in the United States, we obtain some of our best results, is derived from the country to which we owe our origin. It is imperfectly understood on the Continent of Europe, and is but feebly applied even in those countries where a semblance of political freedom exists. The government too often assumes the power to direct the mind and to control the will.

Prussia has undertaken to show what an "enlightened despotism" may effect, and the results of her combined educational, military, political, and religious system, yet remain to be fully developed. The rulers have had their preferences in regard to the encouragement of different departments of agriculture and the arts. At one time, the silk culture, and the manufacture of silk and porcelain, were especially patronized; at another, brass and iron founding, and the culture of the beet, and the manufacture of sugar from it. The minutiæ to which the government descends, may be perceived from the fact that licenses to follow trades and occupations, the results of which concern human life, (as those of the druggist and chemist, of the architect and builder, of the mason and carpenter, and even of the well-digger,) can only be had upon an examination upon certain preliminary acquisitions, deemed essential to the prosecution of each.

The recommendation of general measures for promoting the interests of the useful arts, is entrusted to a technical commission connected with one of the departments of the government. A society is also permitted in Berlin which takes cognizance of inventions submitted to it, which meets at stated times to discuss reports upon alleged inventions or improvements, and under the nominal patronage of which a monthly journal is published. To provide for the technical instruction of those who intend to follow mechanical employments, schools have been established in many of the provinces, to be entered after the usual period of elementary instruction is passed, and before an apprenticeship is commenced, or during its first years. The most promising pupils of these schools are transferred, after serving a portion of the time of their apprenticeship, to a central school, at Berlin, where they receive, free of expense, instruction in the branches which may fit them for the occupation of machinists, founders, and the like. Architects, builders, and engineers, have a similar public institution, for the preparation of the members of their professions. The Trade Institute of Berlin turns out annually a class of well educated young men, whose influence on the occupations which they embrace, must ultimately be of the highest benefit.

The plan and execution of that great scheme of uniting the States of Germany, once loosely connected by political ties, in a commercial league, is due to Prussia, and now the toll-league embraces nearly all the States of the old German empire, except Austria. A uniform scale of duties is adopted by all, and import duties are collected at the frontiers, to be distributed in proportions agreed upon by the several parties.

Austria has *her* way of encouraging manufactures and the mechanic arts, different from that of Prussia. Her manufactures of porcelain, of iron, of linen, of sugar, and of chemical products, have in turn been aided. Her quicksilver mines and porcelain manufactory belong to the government, and the former are worked by a corps specially organized for the purpose. The government has established trade schools, like those of Berlin, in some of the provinces, but their great *Polytechnic Institution* is in the capital itself. No expense has been spared to collect in this establishment the best specimens of the materials used in the arts, of the tools and machines (or models of them) employed in the different manufactures, and of the products of industry. All are used for the purposes of instruction in the technical schools, and are accessible to the mechanic. One portion of the immense structure is occupied by the rooms devoted to these collections, and to models of architecture of various kinds and of different countries. In one of them is a model of that admirable structure, now lost to us, the work of an American mechanic, the wooden bridge at Fairmount; and it would be curious if one day a Philadelphian should bring back a copy of it, to place in the hall of the Franklin Institute of Pennsylvania.

The late emperor, when heir apparent, vieing with that department of the government which had charge of the polytechnic school, collected for himself a vast museum of materials and products of the arts, presenting not only the results of Austria, but of the world—a standing exhibition of the works of the useful and decorative arts.

The stranger must be struck with the magnificence of the pile thus reared by imperial munificence, as the temple of the useful arts—and as entering the spacious gates, he passes through the halls devoted to elementary instruction in science and languages, to the higher branches of practical science, through the laboratories only rivalled by one among ourselves, through the extensive range of rooms for the display of materials of the arts, of models, of fabrics, of machines—through the work-shop, whence some of the most accurate instruments have proceeded—through the immense galleries, devoted to a standing exhibition of the arts, manufactures, and agriculture of Austria—he cannot but admit that in *this* at least the government has wisely appropriated the means derived from the people for the people's good.

It is admitted by all, that in the arts depending upon chemistry the existence of that institution has already produced important effects, and it is generally believed that the view there afforded of the comparative essays of different manufactures has led to the improvement which the products of Austrian industry have exhibited at the German fairs.

Whether practical instruction in the workshop should precede or follow the theoretical instruction of the schools, is a moot-point. An intelligent iron master of Styria thought he had found the true solution to the problem, by bringing up his sons, from the time of finishing their elementary education, at the forge and furnace, and at the end of their apprenticeship sending them to the technical schools. On the contrary, the Prussian educates for the workshop in the school, requiring each pupil to go through a course of practice there—and in Dresden, the apprentices who are pupils of the Saxon Trade School, work during a part of the day, and receive their technical instruction during the remainder, thus mixing theory with practice.

We may admire the efforts of the Austrian and Prussian commissions, but after all, the plodding spirit of routine which clogs the limbs of activity in these countries, renders the measure of success of the plans *there*, no scale to judge of what would be accomplished where the load of despotism was not to be borne forward.

France has halted in her scientific career since the youth of the nation have drunk so deeply of the excitements of political life. In Paris, the periodical exhibitions of the manufactures of the kingdom, are doubtless not without their influence. The Conservatory of Arts and Trades—a fine array of models and machines—chronicles the various improvements in each branch of art. The lectures of its eminent professors spread before the student the scientific principles which he is to use. A few members in the National Institute give a representation to the arts. But these are acquisitions of a past day. The trifling public aid extended to the School of Arts and Trades in Paris—the stationary condition of the Sevres porcelain factory—the diminished glory of the Gobelins—the attacks in the Chamber of Deputies upon the Industrial School of Chalons—do not speak of progress in the old way of government support, and no new one has come into operation to replace it.

It would be easier to generalize in regard to the United States, extending as it does through twenty-six degrees of latitude and eighty-three of longitude, than in relation to the small territory of GREAT BRITAIN. If an Englishman's house is his castle, his workshop is its citadel. The establishment of Bolton & Watt is not open even to strangers, and strangers may pass into many not accessible to townsmen. Keen competition keeps men much asunder.

The Manchester man would care little for an exhibition which would bring to his town the iron of Glasgow, or the cutlery of Sheffield. Besides, neither his customers nor his judges are to be found at home. Rodgers displays his cutlery in his shop, because all great manufacturers have a show room; but he looks to America for his gains, and his agent in London occupies a small shop in an obscure street. Mackintosh cares little whether the colours of his dyes suit the "Glasgow folk" or the "Edinboro' gentry" or not, and Strutt does not make his woolens for the consumption of Derby.

The home market is comparatively of little importance. Every man endeavours to improve as fast as he can, to surpass his neighbour—to keep, as far as he can, the ascendency which skill, or talent, or capital may have given him. The attempt of the British Association at Newcastle to bring together the products of the arts and manufactures, was but very partially successful, and it was thought that if this had been made by practical instead of scientific men, it would have failed entirely.

Are we to infer from this, that exhibitions andcollections in the arts, and the diffusion of knowledge in regard to them, are all useless? England is the workshop of the world. To what purpose do we toil to promote that which can and will take care of itself? Let us examine this argument a little. Are we sure that things might not be better under a different system, even in England? Who shall say what progress the English manufacturers and mechanics might have made, had their energy been aided by greater publicity—by greater facilities for comparison? One thing may positively be affirmed, that no patriot would exchange the neglect of education on the part of many of their opulent mechanics and manufacturers, of self-improvement out of the immediate line of the workshop, of good manners and address, for the strikingly reverse trait which obtains among so many of our men of equal resources in the arts. Education make a mechanic! says the objector. Watt was educated a surveyor—Arkwright a barber—and yet the one was the great inventor of the useful form of the steam engine, and the other of the jenny. What use of schools for special instruction in mechanics? This objection might, perhaps, have some force, if all men were Watts and Arkwrights, if there were no *common* minds to train. It would have more force if there were no education but to make certain forms of letters, and to construct sentences, and to add numbers. Away with such limited views of education! Were Watt's powers of observation and reflection not educated? Were Arkwright's powers of invention not educated? Their lives show how *the circumstances in which they were placed educated* them for their very inventions.

But if this argument is worth any thing, it is worth carrying to its full consequence. Because Burritt was brought up a blacksmith, Lukens a farmer, Baldwin a jeweler, Merrick a merchant, and Morris a druggist, we should make linguists by putting our sons to the anvil, mechanicians by requiring them to follow the plough, builders of locomotives and steam engines and machine makers by apprenticing them to the details of filagree work, of accounts, or of pharmacy. This seems the legitimate inference from the argument of those who, because English manufacturers and mechanics are great in their lines, would eschew schools, lectures, cabinets and exhibitions. Ask the men themselves whom I have referred to, how *they* would desire to educate *their* sons—how they would wish to have been educated, were their lives to be passed over again. Hear from them the difficulties which they have encountered for want of a different schooling. Hear from them the circumstances which have really given them their schooling. The school of life and practice is one of the hardest in which men are educated. Men who are educated in it are planting in growing time, and may be considered happy indeed if they reap before winter.

But have no attempts been made in Britain to improve the mechanic as an intellectual being? Professor Anderson, of the Glasgow University, dissatisfied with the narrow regulations which constrained the institution to which he belonged, left by will his apparatus and a small legacy to found a more liberal school. Dr. Birkbeck endeavoured to make this small foundation available for the instruction of mechanics, and classes were opened for their benefit in the institution. Voluntary associations of mechanics, under various titles, sprang up under the direction of Birkbeck and his associates, and for a time promised great things in the culture of both the adult and the youthful mind. They usually combined public lectures in chemical, mechanical, and general science, and classes of mathematics, of English, modern languages, &c., for the sons, wards, and apprentices of members. Many of them are still in existence. Some have taken root, but are found to be supported more generally by merchants of various grades than by mechanics. From the example of these associations, others for very popular instruction have been established, giving lectures at moderate rates on geography, history, and the elements of natural science.

Some of the institutions for the promotion of the arts award prizes for special excellence in particular objects to manufacturers and mechanics, and also to the successful pupils of their schools. The Society of Arts of London, and that of Scotland, give premiums for meritorious inventions submitted to them; have papers read before them, by members, on new inventions, and the former association publishes its transactions. Each has a meeting for the public award of premiums. The Royal Institution of London, at its Friday evening meetings, calls frequently on mechanics for lectures, explaining their arts and trades, and the improvements in them. These and similar efforts contribute to diffuse and to increase knowledge. If the results seem to be small, lost in the great stream of improvement which ever flows onward; yet in mingling with it, they impart at least some small motion to its mighty mass. The collision of mind with mind that takes place in these numerous associations, is of high importance; the tendency is to make men aware of their own deficiencies and to furnish a motive to supply them, to liberalize the feelings, to promote mutual confidence, and to produce esprit de corps. These results are of inestimable value in the aggregate.

The low wages of operatives generally in Europe, low relatively to the prices of conveniences, tends to keep the mass of them from intellectual improvement. Their youth is passed before they can judge of the necessity for culture, and when manhood is reached, the cares of providing food and maintenance for themselves, and usually for a family besides, press upon them so heavily, that they have time to think of little else. Until the means of life are more uniformly distributed, the mass of the mechanical population of Europe cannot become intellectual. The advantages of a different system of things, which exists with us, we should never lose sight of—never let go. It is not true that the necessaries and comforts of life are higher with us in the same proportion as our wages. The life of the

American working-man is not that of the European. Besides that his inestimable political rights put him on a par as a citizen with every other citizen, he occupies a different place in the social scale—may, by education in school and out of school, put himself on an equality with any other citizen—and may have comfort and competence for himself and his family. Thus relieved from the grinding pressure of want, wo to him if he slight the privileges bestowed by a bountiful Providence! Wo to him if he forget that he has a mind and soul as well as a body—an intellectual and moral as well as a physical nature!

Which of all these plans, devised by the intelligence of so many minds, for the *improvement of the useful arts, and of their cultivators,* have we followed out? What new paths have we opened? What success has attended our exertions? Voluntary associations for the improvement of agriculture, manufactures and the arts, exist all over our country, not supported, it is true, by our great sovereign, the people, but by a few, who are either immediately or remotely interested, or who desire to advance the weal of their country. If the eyes of this most august sovereign might but be opened to the importance of fostering these institutions! If for the improvement of the mass, he would but contribute a little of what he lavishes in raising up the political princes of the land! In the olden time, the commons of England gave every ninth sheep and every ninth fleece to their ruler, to enable him to wage war; now a large portion of our commons devote at least the ninth penny to king Party, to enable him to carry on the strife political. Would that they would spare the ninth part of this to put down ignorance and elevate virtue!

In different parts of our country, the modes of action intended to accomplish the great ends to which I have referred, have been various, and attended with very different degrees of success. It will be more proper, as well as more profitable, to look specially to our own doings.

What have *we* done to advance the progress of the useful arts? First, what have been the results of our exhibitions? The same which experience all the world over has shown to result from them. But will it be said by any one, however enthusiastic, that the contrast between the meagre show in the Carpenter's Hall, at our first exhibition, in 1824, and the brilliant display which is just now terminated, is due to these exhibitions, or to those in Philadelphia, New York and Boston, combined? Let us reply by another question. Would we, or would we not, have arrived at the same point without these annual or biennial shows? I answer unhesitatingly, No! It has been remarked of exhibitions of specimens in the arts elsewhere, that though the same artists produce the specimens, there is a steady improvement in them. The taste of the public is improved by them—the taste of the artist is elevated. So, here, observe from year to year the growth in taste of the judges of the different articles submitted at the exhibition, and of the depositors, who are the venders of the manufactured articles. What a powerful reaction must be produced by thus furnishing the vender with the means of accurate comparison, the conclusions from which he may communicate to the manufacturer. Observe the public generally, how the admired articles of one year are the rejected of the next! Listen to the remarks made upon those branches of industry which are stationary. To deal with history instead of what is present; turn to the exhibition of two years ago. Take a branch of manufacture then dead, and compare the effect produced by the well preserved mummies of specimens, though carefully washed and well placed for show, with the results of their first living appearance. The glazing and gilding are untouched, the colours of the painting are as bright as ever, the designs just as tasteful as they were when first exhibited; but the taste of the public is improved, the specimens are returned to their cases, their interest for the future is purely historical —they are deposited among the archives of the arts. The influence of this improvement in public taste alone is not to be rejected.

It is obvious, then, that there are reasons why exhibitions should contribute to *aid* that which requires other causes to support. If they neither form the foundation of the building, nor yet its superstructure, they serve to determine its shape and the arrangement and distribution of its parts.

The influence of the medals and certificates awarded at these exhibitions is much undervalued by many, who, looking merely at their intrinsic value, consider them as so much silver or paper. They would value in the same way expressions of esteem as so much breath. The great dramatist has sufficiently held such persons up to ridicule by putting their argument touching honour in the mouth of that impersonation of all that is ludicrously contemptible—Falstaff. These testimonials have, however, a value in dollars and cents, which, though *I* cannot precisely estimate it, others may. Those who know enough to be aware of their own ignorance, look to others who have knowledge to guide their opinions. Thus the opinions of the judges, expressed at the exhibitions, become the guides of many and many purchasers, who seek or reject, not according to their own judgments, but according to the decisions of the Institute. Rely upon it, these exhibitions and the premiums awarded at them, have a powerful action upon the consumer, the vender, and the manufacturer, and through them upon the arts.

These periodical exhibitions are times of high excitement in the Franklin Institute. The public is called in, and the members are their entertainers. The fly-wheel of the institution appears to have been thrown out of gear, and the motion is rapidly accelerated. It could not exist under a long continued action of this sort. Why should not provision be made in the ordinary and regular working of the Institution for a constant exhibition? Why should all these products once collected be dispersed, never again to be re-united? Like the Conservatory of Arts, of Paris, or the Trade Institute, of Berlin, we should find such a collection a chronicle of the history of each art in our country. As in the Polytechnic Institute of Vienna, we should find by the side of models and machinery, the raw materials and products of our manufacturers and arts, from the date of their introduction, or use, to the day of exhibition. Were our *Sovereign* prepared to erect the piles of the Conservatory or of the Polytechnic school, we should easily find articles to fill their ample halls,—and is it impossible that this should ever be? Look at the structures raised by the public for education. Who would have believed forty years ago, that such would now exist by the means which have raised them? Voluntary association may do much, but not everything. The desire to accomplish this, among other purposes, led to the attempt to extend the accommodations of the Institute in 1835. Perhaps under other circumstances we might have succeeded. Had the tide continued to rise, instead of beginning to fall, we might have passed the shoal, and found ourselves in smooth water on the inner side. We may now be satisfied that having ventured much for a great good, we are still safe. This branch of our Institute must bide its time. Meanwhile, the exertions of the Professors and members are forming the nucleus of cabinets of models and products of the arts, which promise to become of value; and the steps taken by the Managers to obtain from depositors specimens of those articles which take premiums or certificates, where the nature of them admits of it, will, if met in the spirit of liberality by the contributors, soon secure a useful and large collection. How interesting a view would have been presented of the progress of American arts, had such specimens been collected at all our Exhibitions! And while on this theme, does not memory call before us one dear to the Institute, as among its earliest friends, its founders, its first Professor of Chemistry, who made the earliest beginning of our cabinet of arts and manufactures, whose zeal and judgment connected him with our best and most useful efforts—though removed from us by death, he lives in our affections, and his name will be perpetuated in the history of our Institution. We already begin to have a history. Already the obelisk is raised, upon the base of which the names of the useful, zealous, and able, among the members of the Franklin Institute, are to be inscribed at death—that tablet bears even now the names of Keating and of Ronaldson.

The awarding of premiums for inventions, though distinctly different in part of its operation from similar awards for the best specimen of any art, owes its efficacy to the same principles. It is not the value of the prize, but the value of the opinion, which causes the inventor to submit his designs for examination. This consideration of inventions forms part of the everyday business of the Institute. Formerly it was done by the Committee on Inventions, and now by the Committee on Science and the Arts, formed by the voluntary association of the members of the Institute. The time and capital which have been saved to projectors, and to those who furnish them with means, through this Committee, are not the least important of its results. Men who were flattered at home with the idea of being Fultons and Watts, have found that, after all, Fultonism is not so easy of attainment; and those who were prepared to embark their means in schemes, have been saved both money and chagrin. Our countrymen are yet favored, occasionally, with the *novel and astounding* sight of vessels torn to pieces by the destructive agency of gunpowder, fired by the also *novel* method of a wire, heated by means of a distant galvanic battery—and all at the expense of the United States. With the explosion of unexplodable boilers, or of some old fashioned way of preventing this catastrophe. These things merely indicate, perhaps, a plethora in the National Treasury, or, perhaps, that all knowledge is not given instanter, upon being elected even to high political stations. But, seriously, the award of the Scott's legacy medal and premiums, which our City Councils have delegated to the Franklin Institute, is the source of much usefulness, and, coupled with the opinions given by the practical and scientific men who are united in the Committee of Science and the Arts, has worked good to the arts, their cultivators, and their patrons.

In nearly all the institutions abroad to which I have referred, the publication of a journal in which to record inventions and improvements in the arts, and discoveries in the sciences which bear upon them, is regarded as of high importance. It is obvious, indeed, that this is the only effectual mode of diffusing a knowledge of improvement over a wide space. In days gone by, the mechanic of Continental Europe passed part of his apprenticeship in wandering from place to place, to practise his art, as a means of support, and gathering the improvements which might have been made in it, to turn to account on his return home. Now the Journal brings to his door the improvements of the most distant places, with all the rapidity which steam navigation and railroad transit can give. There can be no doubt that of all the means of usefulness of the Franklin Institute, the publication of its monthly Journal is most widely operative. Its readers find a chronicle of the ingenuity of our country in the patents recorded in its pages, while they find the wheat separated to their hand from the chaff, winnowed by the labors of one who brings knowledge unsurpassed in this department to the execution of his work. Copious extracts from foreign journals convey the improvements of Europe to our mechanics and manufacturers, while original articles from our own mechanics, engineers, and men of science, contribute their full quota to the interest and usefulness of the work. It was early determined by the Institute that such a journal must be maintained, and the present periodical, originally commenced by the Professor of Mechanics, was adopted. The expensive nature of the work, its low price, and the limited support which it was likely for many years to receive, forbade the idea that it would be a money-making undertaking; and the Institute has been satisfied to support it, as a means of usefulness, at a small annual loss in money. But, for a feature characteristic of the enterprizes of the Franklin Institute, there can be no doubt that this undertaking would have been onerous. Whenever a line of labor likely to benefit the public has been pointed out, and a scheme for rendering it available has been well matured, members have been always found willing to devote their time to its successful execution. It is thus that men engaged in laborious occupations, in which their time and talents are money, have devoted themselves, day after day, to labors enjoined by the Institution, without looking for any other reward than that of being useful. It is thus that the pages of our Journal are supplied with materials, original and selected, (some requiring the labor of translation from foreign languages,) by the generous labors of collaborators, whose zeal is tried by the monthly repetition of its exercise. With all these resources at command, the Institute is still obliged to look to the benefit of this work to the mechanic, as a motive to support its expense, and to wait, in this as in some other enterprises, the time when a greater intelligence in our country at large, and increasing resources, will fully repay the pecuniary outlay annually made.

One branch of the labors of the members of the Franklin Institute has, I believe, no precedent in any similar institution—I mean that of original investigation and research. The Institution thus aids to advance as well as to diffuse knowledge. Of the experiments of the Committee on Water Power, one of the highest living authorities (Mr. Rennie) has spoken in terms of the highest praise. The results of the experiments on the explosion of steam boilers have contributed strongly to turn attention away from imaginary sources of danger, and to fix them upon real ones. The conclusions from some of the more refined and difficult experiments, are quoted in quarters which cannot be suspected of either local or national partiality. These various researches, together with those on the strength of materials, must ever remain a monument of the industry and zeal of the early members of the Franklin Institute. They furnish a claim to public favor and support that no similar institution can justly put forth.

From these extended schemes, in which the members of the Franklin Institute are only incidentally partakers with the public in the common good effected by their instrumentality, let us turn our attention to the special means of promoting the mechanic arts, through the intellectual cultivation of those who pursue them. In the infancy of science, every experiment led to a discovery, and the art offered a scarcely less fertile field than science to their cultivators. Now discoveries in science and improvement in art, are the result of well directed trains of observation, experiment and thought. To direct these, the arts call in the aid of theoretical science. Besides the general cultivation of mind to be derived from pursuing any branch of knowledge, in the sciences of mechanics and chemistry are to be found those principles which alone are safe guides to improvement. It will, perhaps, hardly be believed, but it is, nevertheless, true, that not ten years since there lived in our city an ingenious man, who wasted his time and substance, and the resources of his family, in a pursuit after the perpetual motion. How many such disastrous results are prevented from year to year, by the application of principles taught in the lecture room, may be inferred from the number which require the additional nipping action of the Committee on Science and the Arts. Besides, the lectures upon mechanics and chemistry, which constitute the frame-work of our system, the filling up of architecture, mineralogy, geology and mining, has been supplied by the voluntary contributions of members distinguished for their knowledge, and for their powers of communicating it; and even kindred branches of natural history have been, from time to time, furnished from similar sources.

It has always been the liberal policy of the Franklin Institute, while retaining the control of the institution where, from its nature, the control should be retained—in the hands of mechanics—to call in the talents of other professions to their aid. While by the constitution, two-thirds of the Board of Managers must be manufacturers or mechanics, every citizen is free to become a member. No co-operation is spurned; and in return, knowledge, time, and talent, of various kinds, are at the disposal of the foster mother. This same liberal principle of action shows itself in the very moderate requital expected for all the privileges bestowed, by which membership in the Franklin Institute is placed within the means furnished by the deposit of one cent for each of the working days of the year. Exclusiveness is absent from each and every department of the Institute, and to a degree which, to those who believe such establishments are raised and must be used for the benefit of certain cliques, and the propagation of certain individual influences, is almost startling. What would be thought of raising a voluntary committee of the members of an institution, the annual contribution to which of three dollars makes a member, to consider important inventions and improvements in the arts. Such a thing, the advocates of cliques would say, must lead to confusion. A voluntary committee is wholly uncontrollable—and so it should be. Just such a committee—just so uncontrollable—has existed and flourished in the Franklin Institute for several years, every member being at liberty to join it who is willing to perform the labour required of him. I do not think I overrate the importance of this association of members, when I place it next to the lectures. The library and reading room are no doubt more extensively useful to the members; but the knowledge acquired from books and experience, which is called into action in such various ways, and on so many occasions, in the Committee on Science, and the opportunities for intellectual culture afforded by calm investigation, by cool, but earnest, discussion, and by the appeal to experiment, are so practically improving as to rank above all passive means of cultivation.

Besides the Lectures, the Library, and the Committee on Science, the Monthly Conversation Meetings serve as rallying points—as opportunities of giving instruction or of being instructed in the scientific or mechanical novelties of the day. In a large metropolis like London, it is always possible, during at least a part of the year, to obtain materials for even weekly meetings of this sort. At the Royal Institution of London, there is an informal lecture at least once a week, corresponding somewhat to our Conversation Meeting. If we could concentrate here the novelties which in our country find vent through various channels, we should be able to carry on these meetings with more spirit than is now done. In the meantime, they are often both agreeable and useful, and, doubtless, will be kept up with occasional intervals.

While thus providing for the improvement of its members, the Franklin Institute has not forgotten their families, their wives and daughters, as well as their sons, wards, and apprentices. When the lectures of the Franklin Institute first commenced, ladies were not in the habit of attending lectures—in other words, custom most ungallantly excluded them from opportunities of intellectual amusement and advantage. The Institute has turned custom out of the doors, and taken the ladies within them.

A series of schools for youth at one time entered into the plan of the institution. Of these, the drawing school alone is still kept up with an efficiency and advantage which command patronage. I have very little doubt that had not public education taken the new position it now occupies in our city, these designs of the Institute would have been extended. The sovereign has now awaked to the advantages of supporting public schools by public means, although not yet fully prepared to push the principles upon which they are based to their utmost limit.

Among all these means of usefulness, there is no School of Commerce and the Arts like the Polytechnic Institution of Vienna, no School of Arts and Trades like the Berlin Institute, no School of Arts and Manufactures like the Paris Institution. The establishment of a School of Arts has been a favourite project with the Franklin Institute, but thus far has scarcely passed beyond a project; at one time on the point of receiving aid from the Commonwealth, at another almost put in operation by individual enterprize. This object requires means, and these we have not at our disposal. Will public opinion ever so far ripen as to furnish these means? This is an interesting inquiry. I have heard it remarked by more than one person conversant with the minutiæ of the institutions of Philadelphia, that all the enterprizes for the diffusion of knowledge are supported by a small portion of our population; and yet they are intended for the ultimate good of *all*, and should be supported by the *whole community*. There was no doubt a time when the idea of paying for the support of a fire department would have seemed preposterous, and now we quietly pay for insuring our houses, and then in addition, a portion of our taxes goes to furnish the means and appliances for extinguishing fires. What would we think now of supporting a fire department entirely by voluntary contributions? So public opinion oscillates from one side to another. What is at one time impossible, at another is firmly established as the general usage. Where shall we draw the line between that which is to be supported by general assessment, and that by particular contribution? *Shall the principle be that, what is for the good of the whole, shall be supported by the whole?*

It has been long established that the poor must be instructed at the public expense. It is found *cheaper* to educate the masses than to pay for the fruits of ignorance. Besides which, christian charity cares for the souls as well as the bodies of men. But the scheme of public education, free to all, is, even now, and in our own country, very imperfectly understood. Indeed it may be doubted if the public are yet prepared fully to follow it to its consequences. We began, in this country, after the example of the old world, to endow institutions for higher education, universities and colleges. Then we found that this was beginning to build the house at the top. We turned and established schools, common schools, and occasionally a high school. And now the foundation and superstructure have no connexion. Is not this all wrong?

If we want precedent for a different state of things from the old world, we can find it, and so be borne out by experience, as far as institutions trammelled by feudalism can be guides to us. The so-called University of France includes all public instruction within its organization; the highest and lowest are free; why not the middle? why not all?

But it may be said we agree that that which shall benefit all shall be supported by all. We agree that education shall be put upon a *truly republican* basis, that all the schools, from the lowest to the highest, shall be supported from the public purse, that a wider range shall be taken than now in education, and yet the whole shall be supported by the public. But you go further, you ask that institutions for the benefit of certain classes, by name merchants, manufacturers and mechanics, shall be supported or subsidized from the public purse. These classes certainly, in my view, make up no small or unimportant portion of our community. They are surely not so few in numbers, nor so insignificant in influence, that their interests may be overlooked.

But I would go beyond this, and include in one wide system all the institutions of every name for the promotion of knowledge. It is not necessary to weigh their relative usefulness. It would be easy to bring up an array which would include all classes of our community. The Mercantile Library has its objects, the Apprentices' Library others; the Philadelphia Library, the Athenæum, the Philosophical Society, the Academy of Natural Sciences, the Philadelphia Museum, the Athenian Institute, and many similar associations, each and all have their spheres of usefulness. Take them together, do not their objects include in their range the interests of every citizen of Philadelphia? Are they not intended for the benefit of classes which include all? Would not good done to all of them be done to the whole community? If not, let others occupy the vacant ground. Nor would the difficulty of adjusting claims be an insuperable one. For such it never has been in any country where such a plan has been in fact executed, and executed it has been in many, though not perhaps systematised. What, for example, is the support of the Polytechnic School of Vienna, and of its Conservatory, from the public purse, but part of such a scheme? and just such a part as the subsidizing of the Franklin Institute, under its present organization and management, would be. What the establishment of a Museum of Natural History and of Coins and Antiquities, but the support of the Academy of Natural Sciences and the Museum? What the support of a Royal Library but that of the Philadelphia Library? All of these, or nearly all, every where, are under different boards of administration. The scheme is not so Utopian as, at first sight, it might appear. Our schools, colleges, universities, institutes, museums, academies, associations, under whatever name, for the diffusion and advancement of knowledge, constitute an assemblage of objects, embracing within its scope all classes and all interests. Let me commend to your thoughts the idea of forming *a system* from these various parts, not centralized, but like our own political union, each independent, while all are united, *a great system of public instruction, worthy the patronage and support of a free and enlightened people.*

If public opinion were once right in regard to it, the details of the plan would present no serious obstacles. I have just read that a munificent Englishman has left nearly half a million of dollars to two institutions connected with the University of Oxford. Perhaps liberal individuals among us may one day turn their attention to the beginning of some scheme of general secular instruction, required imperiously in aid of moral and religious culture, by the nature of our political institutions. Without intelligence, virtue is comparatively powerless; without virtue and intelligence, liberty degenerates into licentiousness, independence into brutality. Liberty and independence exist but in name. When virtue, liberty and independence fail, the commonwealth which has chosen them as her watchwords, and has emblazoned them with the emblems of agriculture, commerce and the arts upon her arms, will cease to have a being.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Babbitt's Soft Metal Boxes.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination the Manner of Lining Boxes for Axles, Gudgeons, &c. with Soft Metal, invented by Mr. Isaac Babbitt, of Boston, Massachusetts, REPORT,

That they refer to a former report, made in September, 1840; for a description of Mr. Babbitt's improvement. The favourable opinion expressed in that report has been confirmed by experience, and the superiority of the "anti-attrition metal" over common composition for bearings, fully established.

The advantages of this application of soft metal are, 1st, greatly increased durability of wearing surfaces; 2d, diminished friction; and 3d, reduced consumption of oil;—to which might be added the comparatively small cost of both time and money incident to relining bearings when worn out.

Mr. Babbitt exhibited to the Committee some very satisfactory certificates from companies and individuals who have used his boxes, attesting the saving of oil effected, and the greatly reduced wear of the machines, by the substitution of the anti-attrition for composition or gun metal.

The Committee believe this invention to be highly useful and important, and therefore they recommend the award of the Scott's Legacy Premium and Medal to the inventor.

By order of the Committee,

April 14th, 1842. William Hamilton, Actuary.

Report on Naglee's Railway for Short Curves.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a plan of a Railway for Short Curves, invented by Mr. Henry M. Naglee, Civil Engineer, of Philadelphia, Pennsylvania, REPORT,

That in Mr. Naglee's plan the inner curved rail is formed of a common flat bar or edge rail, without a groove, while the outer rail is composed of cast iron segments, with a surface three inches in width, inclined or bevelled inwards and downwards, and containing on the outer edge a flat rim, raised one inch above it, and two inches wide.

By this arrangement it appears that the wheels are kept within the rails by their flanches, as in ordinary roads. The inner wheels always move on their treads. As to the outer ones, since by the motion in the curve the wheels are thrown towards the outer rail, the flanches ride upon its bevelled surface, and may rise higher and higher upon it, until they are checked in this lateral motion by the rim.

A short curve of this kind has been laid at the Willow street depôt in Philadelphia, and has been seen by several members of the Committee in successful operation. Indeed it contains the essential condition of success—namely, that the car is constrained, by the mechanical bonds with which it is confined, to pursue the path marked out for it. All the other plans in use for turning short curves (viz: Stimpson's, Malcom's, and the common track,) have this indispensable character, and with it all succeed, and seem to operate *almost equally well.*

Great importance, indeed, has been attached to the device of virtually increasing the diameters of the outer wheels, by making them rest on their flanches, and thus bringing into action what is called the "conical principle." And it is, certainly, true that if a single pair of wheels, of different diameters, firmly attached to an axle, were to roll freely over a plane, they would move in a circular arc, the centre of which would be the point in which the line of the axle produced would meet the plane. But in every practical case, there are at least two pairs of wheels, attached to axles parallel to each other; and the curves in which they would severally move, if alone, having different centres, cannot possibly be described at the same time. Hence it is evident that when wheels of different diameters are attached to parallel axes, they cannot move at all, either in straight or curved lines, without some of them sliding. There may, certainly, be less sliding where curves are described, with the outer wheels of greater diameter; but if any advantage be thus gained, it does not seem to be of much practical value.

The most usual position for railways of short curves is in the public streets, where they are used for turning corners, or for leading into depôts. In such situations, it is a matter of great importance that the curved ways should be so constructed as not to interfere with the safe passage of common carriages and horses. One of the conditions required for this object is, that the rail be placed as nearly as possible upon a level with the street, and in this case, when the wheel moves on its tread, there must be a grooved depression along the inside of the rail, to admit the flanch. In the plan under consideration, no such groove is admitted, and hence even the inner rail must be sufficiently elevated to keep the flanch above the pavement of the street. As to the outer rail, its elevation will be still greater, in consequence of its bevelled surface and its raised rim.

The Committee do not feel called upon to consider the much agitated question of the comparative merit and originality of the different plans devised for turning short curves on railroads; but, having presented whatbelieve they to be a candid and correct view of the construction and action of that submitted to them, they here close their report. By order of the Committee,

August 11*th*, 1842. William Hamilton, Actuary.

Report on Hill's Occultator.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the model of an Instrument for Calculating Occultations, invented by Mr. Thomas Hill, of Cambridge, Massachusetts, REPORT,

That they have examined the model of Mr. Thomas Hill's Occultator, together with his demonstration of the principles on which it is constructed and used; both of which are entirely satisfactory, and show that by the use of the Occultator, without a table of logarithms, and with the elements given in the Nautical Almanac, or still more convenient, with those of Downes' United States Almanac, the time of beginning and end of an occultation or eclipse may be found with sufficient accuracy for practical purposes. The instrument must be highly useful to those who are desirous of observing occultations, and are not familiar with the use of logarithms and trigonometric formulæ. They would merely remark that instead of the moon's true hour angle and declination, it would be more precise to use those of the star in case of occultations. The model and process are founded on true geometrical principles, and furnish, in the opinion of the Committee, a new application of those principles, and an original invention of an instrument called the Occultator. They respectfully recommend to the Committee on Science and the Arts to advise the bestowment of one of the Scott's medals on its highly meritorious inventor.

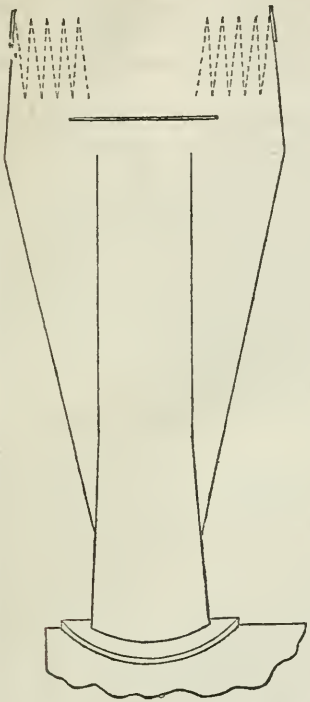
By order of the Committee,

October 13*th*, 1842. William Hamilton, Actuary.

Report on French's Spark Arrester.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Spark Arrester for the Chimneys of Locomotive Engines, invented by Mr. Richard French, of Philadelphia, Pennsylvania, REPORT,

That this contrivance for preventing the emission of sparks from the chimnies of locomotive engines, consists of several broad hoops of sheet iron, in the form of conical frustums, placed so as to encircle each other, and riveted together at the edges, so as to form a series of concentric annular spaces, and to afford a large surface of sheet iron within a moderate circumference. This sheet iron is perforated with a great number of small holes, about one-sixteenth of an inch in diameter, punched inwards to prevent their clogging with soot, and affording in the aggregate an area of opening several times greater than that of the chimney, which is enclosed by the sheet iron case that carries the spark arrester.



If the chimney of the engine be one foot in diameter, the surrounding case, at its widest part on a level with the top of the chimney, may be three feet; and, with nine concentric perforated hoops, each of ten inches or a foot in breadth or height, an area of sheet iron for perforation may be obtained equal to fifty or sixty square feet, which is an ample allowance. A central space, fifteen inches in diameter, directly over the top of the chimney, is left open, for a standing draught, and permits the smoke to escape when the engine is standing. Five inches above the top of the chimney, and three inches below the bottom of the perforated hoops, a circular plate of iron, nineteen inches in diameter, is placed horizontally, which prevents the sparks, when driven upwards by the blast, from escaping through the open space in the centre of the top of the case—which arrangements will more fully appear by inspecting the above diagram. The circular chamber between the chimney and the external case, forms a receptacle for containing the sparks; out of which they pass through an opening made for the purpose. The flat plate above the top of the chimney, prevents the direct action of the blast against the perforated iron, and reflects a large part of the sparks and cinders, so that they fall into the receptacle by rebounding from the plate.

The best test of the utility and efficiency of a spark arrester, is long-continued experience. Mr. French's contrivance has been in daily use upon the Philadelphia, Germantown, and Norristown Railroad, for nearly a year, on three of the locomotives, and has given great satisfaction in arresting the sparks without stopping the draught, being found much superior to several others that have been tried, the fuel used being pine wood. When the engine is running with the fire box full, no sparks are seen; when fuel is added, a few may escape, and when near the end of a trip, a few brands only remain on the grate bars, the most sparks find their way out, but they are so small as not to cause danger. Although more or less dust escapes with the smoke, there is nothing which burns the clothes of either the conductors or passengers.

The present spark arresters have five hoops, with about forty feet of surface, and holes one-sixteenth of an inch in diameter. It is thought that less dust will escape if the surface is increased and the size of the holes diminished.

Those who have traveled much on many of our American railroads where pine wood is burned, are aware of the great annoyance of the sparks, particularly in warm weather, when the windows of the cars are open; and on some lines, the engines are followed at night by a fiery trail of great length, which, however beautiful an object to the spectators at a distance, is anything but agreeable to those within its reach. Mr. French's contrivance is one of the best and most durable devised for abating this nuisance; it is not expensive to construct, and is well worthy of the consideration of gentlemen interested in railroad transportation.

By order of the Committee,
September 8*th*, 1842. WILLIAM HAMILTON, Actuary.

Mechanics' Register.

SPECIFICATIONS OF ENGLISH PATENTS.

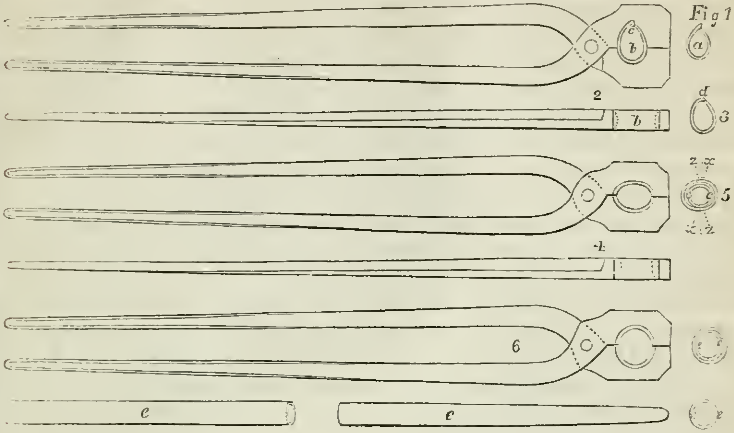
Specification of the Patent granted to THOMAS HENRY RUSSELL, *of the County of Stafford, Iron Tube Manufacturer, and* CORNELIUS WHITEHOUSE, *of the same place, for Improvements in the Manufacture of Welded Iron Tubes.*—Sealed March 7, 1842.

To all to whom these presents shall come, &c. &c.—Our invention relates to improvements in welding the joints, or seams, of wrought iron tubes, when made by external pressure, by passing the iron in a welding state between dies, or through holes; and the improvements consist of a means of employing internal support, and in such manner that the instrument which gives the internal support being introduced into a partly formed tube, is caused to pass with the tube through the dies, or holes, used, by which the requisite external pressure is obtained; and when the weld is completed, the instrument used for giving internal support, owing to its being of small diameter when compared with the diameter of the finished tube, may readily be withdrawn by causing the welded tube to be pressed into a cylindrical form. And in order that our invention may be most fully understood, and readily carried into effect, we will proceed to describe the accompanying drawings.

Description of the Drawings.

a, fig. 1, represents an end view of a skelp of iron turned into the shape shown. This skelp being heated to a light or moderate weld-

-ing heat, is drawn through the tongs, *b*, fig. 2; these tongs have a bell, or enlarged mouth opening, and the upper part at *c*, is so sunk as to cause the turned skelp of iron to assume the shape shown at fig. 3—



one edge of the skelp touching the inner surface at the other edge of the skelp, which is caused to overlap, as is clearly shown at *d*, and a partial weld is thus effected. A cylindrical bar, or rod, of iron, *e*, is then introduced into the interior of the skelp, or partly formed tube, and the skelp, or partly formed tube, is to be heated to a welding heat, and then, by means of a draw-bench, the tube, with the instrument, *e*, within it, is drawn through the hole in the dies, or tongs, fig. 4, the pressure being in the direction of the dotted line, *y*, *y*, by which the metal of the joint, or seam, will be pressed together, and the instrument, *e*, which will not have become very highly heated, will be securely held in the tube. The tube being kept at a welding heat, is turned round slightly, and again drawn through the hole of the die, or tongs, fig. 4. In this instance, the principal pressure will, however, be in the direction of the dotted lines, *z*, *z*, in fig. 5, and the seam, or joint, will be pressed on a little on one side of the central line thereof. Then the tube is again drawn through a hole in the tongs, or dies, fig. 4, which are caused to give the principal pressure a little on the other side of the central line of the seam, or joint, as is indicated by the dotted lines, *x*, *x*, fig. 5, the tube being turned in such manner that the tongs may grasp it in the positions indicated by the dotted lines, *x*, *x*, and *z*, *z*, by which means a very effective lap-joint and weld will be obtained to the tube. We prefer to use three pair of tongs, fig. 4, for this purpose, so that the tongs used for each time of drawing may be immediately put into water, and any scale which may adhere removed. The tube is then drawn through the hole in the die, or tongs, fig. 6, which causes the tube to assume a cylindrical shape; and, owing to the smaller diameter of the rod, or bar, *e*, it will be immediately released, and may readily be withdrawn from the welded tube.

We would remark, that we prefer the pressing dies used to be in the form of tongs, owing to the cheapness of their construction and the facility they offer for being cleansed, by dipping them in water after each time of use, when the scale (if any adhere) may be readily removed; such construction of dies also allowing the workman to change from one size of tube to another more readily. At the same time, we do not confine ourselves to the use of dies in the form of tongs, as grooved rollers or other dies—such, for instance, as are described in the specification of Cornelius Whitehouse, of the 26th day of July, 1825—may be used for performing the welding process when the internal support, *e*, has been introduced; but we consider hand dies in the shape of tongs to be the best. The workman in using the tongs rests them against a suitable stop formed on the draw-bench, and he causes the parts of the die to close as the tube begins to pass through the die.

We would also remark, that the dies, and the manner of using them, shown and described, are very similar to those now used in the making of welded iron tubes, according to the specification of the former patent granted to the said Cornelius Whitehouse, they differing only in the shape of the bell mouth given to them respectively.

And we would wish it to be understood, that we do not claim the using of such dies when uncombined with the use of an internal support, *e*, similar to that shown in the drawing, nor do we claim the use of an internal support when using external pressure in welding iron tubes, unless the instrument for giving internal support be such as to pass with the tube through the holes, or dies, used, and offer internal support from end to end of the seam, or joint, of the tube, which is to be welded; the bar, or rod, *e*, being of such diameter, in respect to the tube, that on shaping the tube, the bar, or rod, *e*, shall be released, as before mentioned, so as to be readily withdrawn, owing to the smallness of the diameter when compared with the tube welded thereon. It will, therefore, be seen, that the tube does not move or slide on the bar, or rod, *e*, when the process of welding is being performed. In order to obtain lightness of the instrument, *e*, used for giving internal support, we prefer that it should be hollow, and we have used strong welded iron tubes for this purpose. The instrument, *e*, is longer than the tube welded thereon, and protrudes a short distance through at each end; and care is to be observed in raising the tube to a welding heat, that the ends of the partly-formed tube, and also of the instrument, *e*, are to be kept out of the strong action of the fire, in order to prevent those parts being raised to a welding heat. For this object we have a hole at the back of the furnace for the end of the instrument, *e*, to protrude through, and for the end of the tube to enter, so that the heat is applied to the tube only, and not quite up to the end thereof; and when the fire, or furnace, is not sufficiently long to heat the length of tube desired at one heat, then we first make the tube in the manner described above, for a part of the length of the skelp, and when the same has been cooled, we insert the instrument, *e*, and finish the other end of the skelp by raising it to a welding heat, and drawing it in like manner to the first end of the skelp. The tube thus made is subsequently raised to a bright red heat, or a moderate welding heat, and is drawn through a pair of dies rather less than those at fig. 6, which slightly reduces the diameter of the tube, and brings it to the size desired. The tube is then to be straightened as heretofore, and the ends cut off, when the tube will be complete. We prefer that the instrument, *e*, should simply be straightened, and not cooled down between each succeeding tube in which it is used, it being desirable to keep the instrument, *e*, hot. We would observe, that this invention is particularly applicable when thin welded iron tubes are desired, such as for the tubular flues of locomotive, or similar steam-boilers, for which purpose we are now using iron of No. 14, of the wire gauge, and we are now making such tubes from one and a half to two inches diameter; but these dimensions may be varied. The drawings show the size of the bar, or rod, used, when making tubes of two inch internal diameter; and it will be evident that the diameter of the bar, or rod, *e*, will be varied according to the size to be made.

Having thus described the nature of our invention, we would wish it to be understood that we do not confine ourselves to the various details shown and described, provided the peculiar mode of applying internal support, combined with the welding of wrought iron tubes by external pressure, be retained, whereby a bar, or rod, *e*, though of much smaller diameter than the tube welded thereon, is caused to give efficient support to the seam, or joint, of a tube, when being welded by external pressure, and whereby the bar, or rod, *e*, is caused to pass under pressure with the tube, and be released after the weld is obtained by the subsequent shaping of the tube, as above described.

THOMAS HENRY RUSSELL,
CORNELIUS WHITEHOUSE.
Lond. Repertory.

Specification of a Patent granted to JOHN CARR, *of North Shields, and* AARON RYLES, *of the same place, for an Improved Mode of Operating in certain Processes for Ornamenting Glass.*—Sealed May 9, 1842.

The "improved mode" here patented is stated to consist in the application to glass "of the process usually called by glass-stainers *printing*, with materials which have not heretofore been used in that way, and under circumstances which give great facility for, and make great improvements in, ornamenting glass."

First, as regards the *staining* of glass, the improved mode of operating is stated to be as follows:—"Instead of mixing the staining materials now in use for that operation, when levigated finely and dried, with oil of turpentine, or other volatile oils, or water, as usual, we mix them with boiled linseed, or other oil, such as is now used to mix with enamel colors, when printed on glass; and instead of floating the staining materials over the glass in a liquid state, as is now practised, we print them on, or transfer them as impressions from, metal plates, in the manner now adopted in the operation of printing enamel colors, and proceed, after the material transferred has been well dried, to fire it for the color required, in the usual way. When we operate with the same staining materials, so mixed with oil as aforesaid, on what is called pot metal, or on pieces of glass which are what is called 'flashed,' opaque and transparent shades are produced, leaving the surface of the glass quite smooth, and not raised in those parts, as in the common mode of applying body color for the purpose of shading."

Second, as regards the operation of what is called *stopping-out*, the patentees give the following directions:—"We also mix the materials used for that purpose into a composition with boiled oil, as aforesaid, and transfer printed impressions on to the glass with it, as before explained, covering such parts as are not to be acted upon, and can then float over the whole surface, including the parts so stopped out, with liquid staining composition, and fire it as usual, to produce the stain; after which, the glass being cleaned, the pattern so printed on it in stopping-out materials, is exhibited in the original color of the glass, and quite distinct from the stained ground; or a printed impression being transferred to the glass in stopping-out materials, as aforesaid, the remainder of the ground may be obscured, as it is called, in the usual manner—thus producing transparent patterns on obscured grounds."

Third, as regards the operation of what is called *obscuring* glass, the patentees say:—"We also mix the materials which are used to produce this effect with boiled oil, and transfer impressions from engraved metal plates on to the glass; this produces obscured patterns on transparent grounds. Now, whereas, it is evident that in all processes for ornamenting glass, by staining, stopping-out, or obscuring, the means we have discovered of mixing the staining, the stopping-out, and the obscuring materials, with boiled linseed oil, so as to enable us to print with the composition from copper, or other engraved metal plates, gives us the power of greatly improving, perfecting, diversifying, and multiplying, the combinations of patterns, grounds, and devices—while it does not deprive us of the aid of enamel colors to add to that diversity as usual."

The claim is to the use in those processes for ornamenting glass, where staining, stopping-out, or obscuring materials, are employed; of 1st, the mode before described of transferring the said materials in the form of impressions from engraved plates of metal on to the glass, in the same manner as now practised in printing in enamel on glass, namely, by mixing the said materials with boiled linseed or other oil, and 2nd, of the application of the staining material, so mixed with oil, to pot metal or to flashed glass generally. The patentees add, that by "the said improved mode of operating with the said materials, we are enabled greatly to improve, perfect, render more exact, diversify, and multiply the combinations of patterns, grounds, and devices for ornamenting such glass as aforesaid, and to produce the same, so ornamented, at a cheaper rate." Mech. Mag.

Specification of the Patent granted to Goldsworthy Gurney, *Esq., Bude, Cornwall, for certain Improvements in the Production and Diffusion of Light.*

My invention relates, first, to a mode of improving the illuminating powers of coal gas, by subjecting it to the chemical action of certain substances hereafter mentioned, in its passage from the gas main to the burners.

Secondly, my invention relates to a mode of applying reflectors, whereby the light produced may be more beneficially diffused, and, in conjunction with the use of such reflectors, the application of certain glass refractors of light.

Thirdly, my invention relates to the application of gas-burners made of concentric rings of tubing, perforated on the upper surfaces, for the passage of gas, when such burners are used in combination with glass chimnies, for lighting apartments and other places; and,

Fourthly, my invention relates to a mode of applying conical glass chimnies to lamps, in order to keep the flames thereof quiet, and most beneficially to supply them with air. And in order that my invention may be most fully understood, and readily carried into effect, I will proceed to describe the means pursued by me in carrying out my invention. It is well known that the use of gas as a means of lighting rooms and internal parts of buildings, is comparatively little resorted to, owing to offensive smell, its great heat, and other objections arising from other causes. Now the first part of my invention has for its object the submitting of gas, in its passage from the supply-main to the burner, or burners, to the chemical action of certain matters hereafter mentioned, whereby gas will not only be greatly improved in its illuminative powers, but, at the same time, the heat of the burning gas will be reduced, and its use in rooms and apartments rendered inoffensive. The materials I employ for this purpose are muriate of zinc, sub-acetate of lead, chloride of baryta, and sulphate of manganese; and these materials are to be used either dry or slightly moistened, in similar vessels to what are used in purifying gas by what is called the dry-lime process, by which the gas in its passage through the vessel is caused to pass in contact with as extensive a surface of the materials used as possible. And the object of the invention is to give to the consumer the opportunity of heating the gas to be consumed by him according to my invention, after it has passed through the ordinary processes of the gas-works; and for this purpose I apply a vessel of the description above mentioned to the gas supply-pipe, by which the gas in passing from the gas-main of the gas company, may pass amongst, and be chemically acted on by, the matters above mentioned, or some of them, before coming to the burner or burners. The most important of the above-mentioned materials is the muriate of zinc, and the use of that material alone will be found of great benefit; but I prefer to use therewith a mixture of the other matters above mentioned, and the mixture I have found best for the purpose is as follows:—5 parts muriate of zinc; 2 parts sub-acetate of lead; 2 parts chloride of baryta; 4 parts sulphate of manganese. And I have found that about 6 lbs. of the mixture, placed in a vessel of the description above mentioned, (and which is well known,) and of about the following dimensions: 2 feet 6 inches long, 1 foot 6 inches wide, and 1 foot deep, to a supply-pipe of three-quarters of an inch internal diameter, and in proportion for larger or less supply-pipes, fully answers the purpose; and when in constant use, the materials above mentioned should be changed about every three or four weeks.

I would remark, that although I prefer the above described means of applying the above-mentioned materials, I do not confine myself thereto, so long as the means resorted to are such as to bring the gas in contact with muriate of zinc, with or without other suitable matters, in the passage of the gas from the gas-main to the burner, or burners.

GOLDSWORTHY GURNEY.
Mining Jour.

Specification of a Patent granted to ROBERT STIRLING NEWALL, *of the County of Durham, for Improvements in the Manufacture of Flat Bands.*—Enrolled May 16, 1842.

The improvements of the present patentee consist in manufacturing the flat bands used in mining operations, and for driving machinery, *exclusively of iron or other metals.* Three processes are described. According to the *first*, a flat band is manufactured, by subjecting a piece of iron, or other metal, of good quality—preferring that known as the best charcoal iron, manufactured in the usual way by rolling—to a process of drawing through rectangular orifices, or dies of hardened steel, in the same manner as in the ordinary and well known operations of tube or wire drawing. The patentee considers it to be of importance that the piece of metal to be operated upon should be drawn through the die, in a straight line at right angles to its edge; and as it is difficult to roll iron beyond a certain length, he suggests that it may be found convenient to draw it in a hot state through dies. Again, as in the process of drawing, the metal becomes hardened, the patentee directs that (if necessary) it should be annealed, by heating it in a furnace; and after the oxide has been removed from it, by means of diluted sulphuric acid, that the process of drawing should be repeated when cold. When a band of considerable length is required, it may be necessary to unite two or more bands together. Various methods of effecting this junction are pointed out and illustrated by drawings. Scarfing the ends, and riveting, are considered to be much preferable to welding or brazing, as the operation of hammering in welding gives a brittleness to the metal, which no subsequent process of annealing can remove, so as to give the hammered part the same strength which it had before; and in brazing, the union of the two metals is not such as can be trusted to. These bands, when of iron, may vary in thickness from one-twentieth to one-fourth of an inch, and in breadth according to the strength required. Flat bands, manufactured in the way described, are stated to possess greater strength and durability than those of hemp, or any similar material of the same weight; and if extreme lightness, with the greatest degree of strength, be required, steel may be used instead of iron. In some situations, where the iron becomes rapidly corroded, the bands may be made of copper, instead of iron or steel.

The patentee's *second* improvement consists in manufacturing flat bands of a combination of narrow bands, or strips, of iron, or other metal; which bands, for some purposes, particularly in deep mines, possess advantages over the flat bands before described, on account of the greater security against accident or sudden breaking which such a combination presents. The strips of metal are arranged side by side, and fastened to cross pieces. Metal drawn through dies, as before described, is used, or metal rolled in strips, taking care to select such as are straight and free from flaws, and, if necessary, to cut their edges true and parallel, which may be done by circular shears. The pieces of which the flat band is to be composed, are laid side by side, and kept in a state of equal tension by weights acting over pulleys, while the cross pieces are riveted on, and jointed at the end by a butt, or by an overlap joint. The cross pieces may be from eighteen inches to five feet apart; the breadth and thickness of the component pieces of the band varying according to circumstances.

The *third* improvement consists in forming a flat band by weaving narrow strips, or wires, of metal, in a loom, the strips, or wires, which constitute the warp, being wound on separate bobbins, and kept at a uniform tension during the operation of weaving. It is stated to be, in most cases, advisable to have the wire used as the weft of smaller size than that used as the warp. Mech. Mag.

The Hot-blast Patent.

This patent expired on the 11th of September for England, and on the 1st of October for Scotland, and has proved one out of the few which are eminently successful to the inventor. Besides being of great national benefit, it has realized a sum of not less than £150,000 to the patentees, and has placed John Beaumont Neilson high in the ranks of the benefactors of, not his country alone, but of mankind—iron being the most useful of the metals, and its cheap production of immense importance in arts and manufactures, on which the conveniencies and comforts of life depend. In no small degree has the economising that valuable mineral, coal, been promoted by this discovery; where formerly nine tons were required in Scotland to make one ton of pig-iron, it is now done by two and a half tons, or less, and inferior descriptions of both coal and ore may be used, which before could not be applied; and from this cause a prejudice has arisen against iron made with hot air, which should rather be attributed to those ores and coals which produce weak iron, than to heated air, which, with proper materials, makes as strong, and even stronger, iron than cold air; even the most prejudiced admit this fact in the case of iron made with anthracite coal. The experiments of Messrs.

Hodgkinson and Fairbairn, made under the direction of the British Association, show this fact in iron from the clay ironstones, and also the red ores. It would only be common justice that some national testimonial should be awarded to Mr. Neilson, and it is hoped that some influential party will take the lead in perpetuating the name of a benefactor who may be classed with Arkwright and Watt in the mighty effects of his discovery. Mining Jour.

Practical & Theoretical Mechanics & Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Kalsomine Paint.

In answer to the many applications as to the "material" and "merits" of the Patent Kalsomine Paint, now working so extensively into notice, I avail myself of information derived from practical men in this city, together with the result of my own personal observations, to give some few ideas on the subject.

I find, by test, that the ingredients of which this paint is composed, are, in the first place, removable by water, after their application, but become permanently fixed by a subsequent operation—an advantage to the painter, as thereby he has an entire command over the material he is using; he can apply as much as is required to a wall, or other surface; if necessary, can remove a part, and when the whole is covered to his satisfaction, he renders it insoluble by the application of a "fixing solution," which, combining with the paint applied, fixes it on the wall, or surface, painted. This is an advantage hitherto unattempted in any system of house-painting, places the art of laying and blending colors entirely in the painter's power, and enables him to use pigments which are more solid than those now in use, but which cannot be mixed in oil. From the nature of the kalsomine material, it must offer every resistance to the action of atmospheric agents, a property of the utmost weight. We all know the uncertainty of many of the more delicate tints used for interior house-painting, either in oil or spirit, bearing the action of the light, and the atmosphere, even for a short time, either flying off or turning darker. Not so, however, with the kalsomine colors. These destructive agents do not appear to affect them, judging from specimens of painting executed some time since. In support of what I say, the uniform and fresh appearance of the delicately tinted pearl panels at the Depôt in Broadway, is a case in point; these, to my knowledge, have been painted eighteen months, and as yet no visible change has taken place. An eminent lecturer on chemistry, in this city, agrees with me on this head; on chemical principles he says that kalsomine paint is indestructible.

Kalsomine is made of various tints. From samples of these colors now before me, I find that No. 1 is a pure white pigment, to be used either alone or as a "base," after the manner of white lead, in oil paints; the numbers following, from 2 to 12, are colors for painting the white, all being of exceeding brightness, and withal soft and agreeable to the eye. These are mixed for use according to very simple instructions, given to purchasers by the patentee.

In reference to the material used in the finishing process, by which the paint is rendered fixed, and, consequently, capable of being washed; this is done by the application of what the inventors call a "fixing solution." By analysis, I am unable to my satisfaction to detect *all* the component parts of this solution, but since the material and peculiar method of working kalsomine, is protected by patent,the publication of what I know on the subject would answer no useful end. I can only say that it answers the purpose intended.

The merits of kalsomine painting, compared relatively with the ordinary mode of interior painting, in lead, oil, quips, &c., I should say from my knowledge of both, as far as I can judge, may be reduced to this—from resistance of kalsomic paint to atmospheric agents, the color neither flies off nor becomes darker, which cannot be said in favor of paint in oil or flatting. Kalsomine paint is also more luminous and agreeable to the eye; all the surfaces I have seen painted with it are, certainly, brighter, and at the same time mellower, than anything in "flatting" or otherwise. It has a warmth and glow peculiar to itself, diffusing and softening light, and materially lighting up rooms comparatively dark. Being free from smell, from its nature incapable of injurious effect upon health, and drying in one-sixth of the time of ordinary paint, it is peculiarly advantageous and available to families to whom it would be inconvenient to leave their dwellings while painting. I have myself slept in a room painted during the day, and should not have remarked that it was fresh but for the glow I have already spoken of.

In well kept rooms I believe that kalsomine paint will stand in the ratio of three to one, compared with the old system, in permanence of color. Time will attest what I say, or, with others, I am sadly in error in my judgment.

If I am asked whether kalsomine painting is cheaper than that done by the old method, I answer—the first cost is below that of the old method. Painters in this city, whose work they will warrant to answer the end promised—to be guaranteed by the patentee—offer to paint for me, on plain surfaces, for fifteen per cent. less than they would do the same in oil or flatting. It is, therefore, cheaper, and even at the same price, it is cheaper, if what I have already asserted is correct, being, from its nature, more permanent.

Many other points might be adduced in favor of kalsomine paint, which are obvious from what I have already said, but, per contra, it has its disadvantages when compared with white lead in oil. From the exceeding brightness and delicacy of its tints, it is soiled more readily, and, therefore, for many parts of interior house-painting, it is exceptionable. The idea of introducing kalsomine paint to supersede entirely the use of white lead in oil for house-painting, is ridiculous, if such was ever the intention of the patentees. Kalsomine paint has been washed in my presence, and in some cases I doubt not that washing carefully improves it; but whether, if introduced into the culinary department and the like places, it would stand the operations of careless servants, without being more impaired than the white lead in oil, I leave for others to prove. I should not recommend it for such work.

The foregoing remarks, the result of actual experiment, enquiry, and observation, are offered, believing that they will be acceptable to many individuals, if they have found the same difficulty with myself in obtaining correct information.

In conclusion, if we can get our houses painted cheaper, to look as well and to last as long, to be applied quicker, and without the disagreeable effluvia attending the use of white lead, oil, and turpentine, then is kalsomine paint preferable, and a benefit to the public. The material may be depended on, and all that is to be feared is its injudicious application. W.

New York, October, 1842.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

TO THE COMMITTEE ON PUBLICATION:

Gentlemen:—I am uncertain whether you may not deem the following remarks out of place in the Journal, as they may be supposed more nearly related to the subject of natural history than to those to which your publication is more immediately devoted.

Very respectfully,

THOS. EWBANK.

New York, September 20, 1842.

The Ingenuity of Spiders.

The mechanical resources of the lower animals have often excited admiration, and though no comprehensive and systematic series of observations have yet been made upon them, the time is, I believe, not distant when the task will be undertaken—perhaps within the next century. But whenever and by whomsoever accomplished, the mechanism of animals will then form the subject of one of the most interesting and *useful* volumes in the archives of man.

Among insects, spiders have repeatedly been observed to modify and change their contrivances for ensnaring their prey. Those that live in fields and gardens often fabricate their webs or nets vertically. This sometimes occurs in locations where there is no object sufficiently near to which the lower edge or extremity of the web can properly be braced; and unless this be done, light puffs or breezes of wind are apt to blow it into an entangled mass. Instead of being spread out, like the sail of a ship, to the wind, it would become clewed over the upper line, or edge, like a sail when furled up. Now how would a human engineer act under similar circumstances? But ere the reader begins to reflect, he should bear in mind that it would not do to brace the web by running rigging from it to some *fixed* or immovable object below—by no means;—for were this done, it could not yield to impulses of wind; the rigging would be snapped by the first blast, and the whole structure probably destroyed.

Whatever contrivances human sagacity might suggest, they could hardly excel those which these despised engineers sometimes adopt. Having formed a web, under circumstances similar to those to which we have referred, a spider has been known to descend from it to the ground by means of a thread spun for the purpose, and after selecting a minute pebble, or piece of stone, has coiled the end of the thread round it. Having done this, the ingenious artist ascended, and fixing himself on the lower part of the web, hoisted up the pebble until it swung several inches clear of the ground. The cord to which the weight was suspended was then secured by additional ones, running from it to different parts of the web, which thus acquired the requisite tension, and was allowed, at the same time, to yield to sudden puffs of wind without danger of being rent asunder.

A similar instance came under my notice a few days ago. A large spider had constructed his web, in nearly a vertical position, about six feet from the ground, in a corner of my yard. The upper edge was formed by a strong thread, secured at one end to a vine leaf, and the other to a clothes line. One part of the lower edge was attached to a Persian sun-flower, and another to a trellis fence, four or five feet distant. Between these there was no object nearer than the ground, to which an additional brace line could be carried; but two threads, a foot asunder, descended from this part of the web, and, eight or ten inches below it, were united at a point. From this point, a single line, four or five inches long, was suspended, and to its lower extremity was the weight, a *living one*, viz. a worm, three inches long, and one-eighth of an inch thick. The cord was fastened around the middle of the victim's body, and as no object was within reach, all its writhings and efforts to escape were fruitless.Its weight answered the same purpose as a piece of inanimate matter, while its sufferings seemed not in the least to disturb the unconcerned murderer, who lay waiting for his prey above.

Whether the owner of the web found it a more easy task to capture this unlucky worm and raise it, than to elevate a stone of the same weight, may be a question. Perhaps in seeking for the latter, the former fell in his way, and was seized, as the first suitable object that came to hand—like the human tyrant, (Domitian) who, to show his skill in archery, planted his arrows in the heads of men or cattle, in the absence of other targets. It may be, however, that a piece of stone, earth or wood, of a suitable weight, was not in the vicinity of the web.

To observe the effect of this weight, I separated, with a pair of scissors, the thread by which it was suspended, and instantly the web shrunk to half its previous dimensions—the lower part became loose, and with the slightest current kept shaking like a sail shivering in the wind. A fresh weight was not supplied by the next morning; but instead of it, two long brace lines extended from the lower part of the web to two vine tendrils, a considerable distance off. These I cut away, to see what device would be next adopted, but on going to examine it the following day, I found the clothes line removed, and with it all relics of the insect's labours had disappeared.

Report on the Bude Light. By Andrew Ure, *M. D., F. R. S.*

From the report of a committee of the House of Commons, it appears that this light is so called from *Bude*, in *Cornwall*, the residence of its inventor, Mr. Gurney—a name bestowed upon it at the Trinity House, to distinguish it from the ignited light which he first described in his work on chemistry, in the year 1823.

The Bude light originally consisted of an oil argand flame, having a stream of oxygen thrown up over its internal surface, which produced a very vivid illumination. It was found, however, after having been used for some time in lighting the House of Commons, that oil lamps thus fed with vital air, were expensive and difficult to regulate.

Mr. Gurney then tried to illuminate the House with naphthalized coal gas, in argand burners, similarly supplied with oxygen; and though this produced a light of sufficient intensity, he encountered a formidable obstacle to its continuance from the deposition of liquid naphtha in the tubes of distribution. He next happily discovered a method of obtaining, from ordinary coal gas, purified in a simple apparatus of his own, and burned with oxygen derived from the atmosphere, an effulgence adequate to every purpose of internal and external illumination, which is now used in the House of Commons with perfect success, and at a cost of only twelve shillings per night, whereas that of the candles previously used there amounted to six pounds eleven shillings per night.

This new Bude light possesses the following advantages over all other kinds of artificial illumination hitherto displayed.

First—it gives as much light as the best argand gas flames, with only one half the expenditure of gas. This very remarkable fact was established by experiments, carefully conducted, with the same standard wax candles which I employed for comparison prior to my examination before the late committee appointed to ascertain the best mode of lighting the House of Commons. A common argand gas flame was found to emit a light equal to ten such candles (three to a pound,) and a Bude burner, called No. 10, gave a light equal to 94.7 of the candles. Thus, the Bude flame had nearly ten times the illuminating power of the gas argand flame, while by means of an accurate gas metre, the former was ascertained to consume only 4.4 times the quantity of gas consumed by the latter, demonstrating the economy of the Bude light over common gas to be greater than two to one; and this economy increases in proportion to the magnitude of the light. The source of this surprising superiority may be observed by comparing the two flames: the base of the argand gas flame is of a blue tint for fourteen-sixteenths of an inch, a space in which the gas burns with intense heat, but little or no light; whereas the base of the Bude flame acquires a dazzling whiteness at three-sixteenths of an inch from the metal. Thus we see, that, through a range of eleven-sixteenths of an inch, the common argand gas flame is wasted in producing the nuisance of heat without light.

Secondly—from the phenomena just noticed, as also from the circumstance of the Bude flame emitting a double light with a single volume of gas, when compared with the gas argand, it is manifest that the former, in equal degree, can disengage at the utmost only one-half the heat that the latter does.

Thirdly—the Bude light simplifies greatly the means of artificial illumination, since it concentrates in one flame as much light as will diffuse, throughout a large apartment, a mid-day lustre, which may be softened by shades of every hue, and reflected by mirrors in every direction.

Fourthly—from this property proceeds its value as a ventilator, since the single tube which carries off the burned gases serves to draw out, also, the effluvia from a crowded chamber.

From all these facts, I am of opinion that Mr. Gurney's new Bude light is a most meritorious invention in reference to both public and private buildings, as it removes altogether the objections hitherto justly urged against the use of the highly hydrogenous gas of the London companies in dwelling houses—namely, that its heat is great in proportion to its light, when compared with the more highly carburetted gases of Edinburgh and Glasgow.

The time must, therefore, be now at hand when the great economy and convenience of lighting private houses with gas will be experienced by the inhabitants of the metropolis, as they have been for such a considerable time by those of every town of importance in Scotland.

That the same quantity of coal gas may be made to produce a double amount of illumination in Mr. Gurney's patent burner to that obtained from it in an ordinary argand, will appear to many a paradoxical, if not a doubtful, proposition. Of its reality, however, I am fully convinced, and I think the fact may be accounted for in the following way:

Light, in general, is proportional to the intensity of ignition, a truth well exemplified in the effect of the oxy-hydrogen flame upon a bit of lime or clay. On the same principle, when the flames of two candles are brought into close contact, they afford a compound light considerably greater than the sum of their separate lights. Now, Mr. Gurney's burner gives such a compound flame. It consists of two or more concentric cylinders of flame, mutually enhancing each other's temperature, just as in Fresnel's polycycle oil argand lamps, used in the French lighthouses.

In addition to the augmented intensity of ignition, we must also take into account the peculiar nature of the combustion of carburetted hydrogen gas, whether as generated from coal in a retort, or from oil in a lamp. The vivid whiteness of its flame is due to the separation in solid particles, and subsequent ignition, of its carbon. Pure hydrogen, when burned, affords a very feeble light; and whenever so much air is mixed with coal gas as is sufficient to consume all its carbon simultaneously with its hydrogen, it burns with a dim blue flame.

Now, in the base of a common argand flame, an excess of cold atmospheric oxygen is allowed to act upon the coal gas in the vacant spaces between the pin-holes, whereby the temperature being greatly lowered, while the carbon is consumed in the gaseous state, the light from these two causes is nearly null. It is not till the gaseous mixture rises and forms a continuous hot cylinder, without interstitial streams of air, that it emits a white light from the ignited particles of the carbon precipitated in the interior of the flame.

In Mr. Gurney's concentric series, the prejudicial excess of atmospheric air is prevented, and only so much permitted to come into contact with the gas as will effect the due separation and ignition of its carbon, even at the origin of the flame.

To these two causes conjoined—viz., the increased intensity of ignition, and the limited supply of oxygen—it is that the new Bude flame owes its economy of illumination. The effect of oxygen in excess is elegantly demonstrated by throwing up a stream of it within a gas argand flame, for the light is thus nearly annihilated, while the heat is prodigiously augmented.

As regards the specification of the patent for this improved mode of lighting, which I have carefully examined, I have no hesitation in declaring it, in my opinion, to be valid and unimpeachable.

Lond. Jour. of Arts, Sci., & Manufac.

Notice of Experiments regarding the Visibility of Lights in Rapid Motion, made with a view to the Improvement of Lighthouses; and of some peculiarities in the impressions made by them on the Eye. By Alan Stevenson, *LL. B., F. R. S. E., Civil Engineer.*

In experimenting on this subject, I used the apparatus formerly employed by Captain Hall. It consisted of an octagonal frame, which carried eight of the disks that compose the central part of Fresnel's compound lens, and was susceptible of being revolved slowly or quickly, at pleasure, by means of a crank handle and some intermediate gearing. The experiments were nearly identical with those made by Captain Hall, who contrasted the effect of a single lens at rest, or moving very slowly, with that produced by the eight lenses, revolving with such velocity as to cause an apparently continuous impression on the eye. To this experiment I added that of comparing the beam thrown out by the central portion of a cylindric refractor, such as is used at the fixed light of the Isle of May, with the continuous impression obtained by the rapid revolution of the lenses. Captain Hall made all his comparisons at the short distance of one hundred yards, and in order to obtain some measure of the intensity, he viewed the lights through plates of colored glass until the luminous disks became invisible to the eye. I repeated these experiments at Gullan, under similar circumstances, but with very different results. I shall not, however, enter upon the discussion of these differences at present, although they are susceptible of explanation, and are corroborative of the conclusions at which I have arrived, by comparing the lights at a distance of fourteen miles, but shall proceed to detail the more important results which were obtained by the distant view. Several members of the Royal Society witnessed the results of the experiments, which I shall briefly describe in the following order:

1. The flash of the lens revolving slowly was very much larger than that of the rapidly revolving series; and this decreasing of size in the luminous object presented to the eye, became more marked as the rate of revolution was accelerated, so that at the velocity of eight or ten flashes in a second, the naked eye could hardly detect it, and only a few of the observers saw it; while the steady light from the refractor was distinctly visible.

2. There was also a marked falling off in the brilliancy of the rapid flashes as compared with that of the slow ones; but this effect was by no means so striking as the decrease of volume.

3. Continuity of impression was not attained at the rate of five flashes in a second, but each flash appeared to be distinctly separated by an interval of darkness; and even when the nearest approach to

continuity was made, by the recurrence of eight or ten flashes in a second, the light still presented a twinkling appearance, which was well contrasted with the steady and unchanging effect of the cylindric refractor.

4. The light of the cylindric refractor was, as already stated, steady and unchanging, and of much larger volume than the rapidly revolving flashes. It did not, however, appear so brilliant as the flashes of the quickly revolving lenses, more especially at the lower rate of five flashes in a second.

5. When viewed through a telescope, the difference of volume between the light of the cylindric refractor and that produced by the lenses at their greatest velocity, was very striking. The former presented a large diffuse object of inferior brilliancy, while the latter exhibited a sharp pin point of brilliant light.

Upon a careful consideration of these facts, it appears warrantable to draw the following general conclusions:

1. That our expectations as to the effects of light, when distributed according to the law of its natural horizontal divergence, are supported by observed facts as to the visibility of such lights, contrasted with those whose continuity of effect is produced by collecting the whole light into bright pencils, and causing them to revolve with great velocity.

2. It appears that this deficiency of visibility seems to be chiefly due to a want of volume in the luminous object, and also, although in a less degree, to a loss of intensity; both of which defects appear to increase in proportion as the motion of the luminous object is accelerated.

3. That this deficiency of volume is the most remarkable optical phenomenon connected with the rapid motion of luminous bodies, and that it appears to be directly proportional to the velocity of their passage over the eye.

4. That there is reason to suspect that the visibility of distant lights depends on the volume of the impression, in a greater degree than has, perhaps, been generally imagined.

5. That as the size and intensity of the radiants causing these various impressions to a distant observer, are the same, the volume of the light, and, consequently, *cæteris paribus,* its visibility is, within certain limits, proportionate to the time during which the object is present to the eye.

Such appear to be the general conclusions which these experiments warrant us in drawing; and the practical result, in so far as lighthouses are concerned, seems sufficient to discourage us from attempting to improve the visibility of fixed lights in the manner proposed by Captain Hall, even supposing the practical difficulties connected with the great centrifugal force generated by the rapid revolution of the lenses, to be less than they really are.

I shall be excused, I hope, for saying a few words in conclusion regarding the decrease in the volume of the luminous object, caused by the rapid motion of the lights. This effect is interesting, from the apparent connexion with the curious phenomenon of irradiation. When luminous bodies, such as the lights of distant lamps, are seen by night, they appear much larger than they would do by day; and this effect is said to be produced by irradiation. M. Plateau, in his elaborate essay on this subject, after a careful examination of all the theories of irradiation, states it to be his opinion that the most probable mode of accounting for the various observed phenomena of irradiation, is to suppose that, in the case of a night view, the excitement caused by light is propagated over the retina beyond the limits of the day image of the object, owing to the increased stimulus produced by the contrast of light and darkness; and he also lays it down as a law, confirmed by numerous experiments, that irradiation increases with the duration of the observation. It appears, therefore, not unreasonable to conjecture, that the deficiency of volume observed during the rapid revolution of the lenses, may have been caused by the light being present to the eye so short a time, that the retina was not stimulated in a degree sufficient to produce the amount of irradiation required for causing a large visual object. When, indeed, the statement of M. Plateau, that irradiation is proportional to the duration of the observation, is taken, in connexion with the observed fact that the volume of the light decreased as the motion of the lenses was accelerated, it seems almost impossible to avoid connecting together the two phenomena, as cause and effect. Edinb. New Philos. Jour.

Supplement to a Report upon the Apparatus for Heating and Ventilating the Apartments in the Reform Club House. By ANDREW URE, *M. D., F. R. S.*

The cheering and bracing action of condensed air, and the opposite effects of rarefied air, upon human beings, formed the subject of several fine physiological experiments made a few years ago, by M. Junot, and described by him in the ninth volume of the *Archives Générales de Médecine.* "When a person is placed," says he, "in condensed air, he breathes with a new facility; he feels as if the capacity of his lungs was enlarged; his respirations become deeper and less frequent; he experiences, in the course of a short time, an agreeable glow in his chest, as if the pulmonary cells were becoming dilated with an elastic spirit, while the whole frame receives, at each inspiration, fresh vital impulsion. The functions of the brain get excited, the imagination becomes vivid, and the ideas flow with a delightful facility; digestion is rendered more active, as after gentle exercise in the air, because the secretory organs participate immediately in the increased energy of the arterial system, and there is, therefore, no thirst."

In rarefied air the effects on the living functions are just the reverse. The breathing is difficult, feeble, frequent, and terminates in an asthmatic paroxysm; the pulse is quick and most compressible; hæmorrhages often occur, with a tendency to fainting; the secretions are scanty, or totally suppressed; and at length apathy supervenes.

These striking results, obtained on one individual at a time, with a small experimental apparatus, have been recently re-produced, on a working scale, with many persons at once enclosed in a mining shaft, encased with strong tubing, formed of a series of large sheet iron cylinders, riveted together, and sunk to a great depth through the bed of the river Loire, near Languin. The seams of coal, in this district of France, lie under a stratum of quicksand, from eighteen to twenty metres thick, (twenty to twenty-two yards,) and they had been found to be inaccessible by all the ordinary modes of mining previously practised. The obstacle had been regarded to be so perfectly insurmountable, that every portion of the great coal basin that extends under these alluvial deposits, though well known for centuries, had remained untouched. To endeavor, by the usual workings, to penetrate through these semi-fluid quicksands, which communicate with the waters of the Loire, was, in fact, nothing less than to try to sink a shaft in that river, or to drain the river itself. But this difficulty has been successfully grappled with, through the resources of science, boldly applied by M. Triger, an able civil engineer.

By means of the above frame of iron tubing, furnished with an air-tight ante-chamber at its top, he has contrived to keep his workmen immersed in air, sufficiently condensed by forcing-pumps to repel the water from the bottom of the iron cylinders, and thereby to enable them to excavate the gravel and stones to a great depth. The compartment at top has a man-hole door in its cover, and another in its floor. The men, after being introduced into it, shut the door over their heads, and then turn the stop-cock upon a pipe in connexion with the condensed air in the under-shaft. An equilibrium of pressure is soon established in the ante-chamber, by the influx of the dense air from below, whereby the man-hole door in the floor may be readily opened, to allow the men to descend. Here they work in air, maintained at a pressure of three atmospheres, by the incessant action of leathern valved pumps, driven by a steam engine. While the dense air thus drives the waters of the quicksand communicating with the Loire out of the shaft, it infuses at the same time such energy into the miners, that they can easily excavate double the work without fatigue, which they could do in the open air. Upon many of them, the first sensations are painful, especially upon the ears and eyes; but ere long they get quite reconciled to the bracing element. Old asthmatic men become here effective operatives; deaf persons recover their hearing, while others are sensible to the slightest whisper. The latter phenomenon proceeds from the stronger pulses of the dense air upon the membrane of the drum of the ear.

Much annoyance was at first experienced from the rapid combustion of the candles, but this was obviated by the substitution of flax for cotton thread in the wicks. The temperature of the air is raised a few degrees by the condensation.

Men who descend to considerable depths in diving-bells, experience an augmentation of muscular energy, similar to that above described. They thereby acquire the power of bending over their knees strong bars of iron, which they would find quite inflexible, by their utmost efforts, when drawn up to the surface.

These curious facts clearly illustrate and strongly enforce the propriety of ventilating apartments by means of condensed air, and not by air rarefied with large chimney drafts, as has been hitherto most injudiciously, wastefully, and filthily done, in too many cases.

London, May 21st, 1842. Lond. Jour. of Arts.

Photography.

A very remarkable discovery, with respect to the self-transmitting property of figured surfaces, under certain circumstances, has been recently made by Dr. Moser, of Konigsberg, which would seem to indicate that there is something else than *light* concerned in the production of such effects, and that we must look for some fitter term than *Photo*-graphy to designate the branch of science or art to which they belong. The following is the account of this discovery, brought to this country by Professor Bessel, as communicated by him to the late meeting of the British Association, through the medium of Sir David Brewster, and published in the *Athenæum.*

A black plate of horn, or agate, is placed below a polished surface of silver, at the distance of one-twentieth of an inch, and remains there for ten minutes. The surface of the silver receives an impression of the figure, writing, or crest, which may be cut upon the agate or horn. The figures, &c., do not appear on the silver at the expiration of the ten minutes, but are rendered visible by exposing the silver plate to vapor, either of amber, water, mercury, or any other fluid.

Sir D. Brewster stated that he had heard Professor Bessel say, that the vapors of different fluids were analogous to the different colored rays of the spectrum; that the different fluids had different effects, corresponding to those of the spectrum; and that they could, in consequence of such correspondence, produce a red, blue, or violet color.

The image of the *camera obscura* might be projected on any surface—glass, silver, or the smooth leather cover of a book—without any previous preparation, and the effects would be the same as those produced on a silver plate covered with iodine.

This paper gave rise to an animated conversation, in the course of which M. Bessel said that he had seen some of the pictures taken by this process, which were nearly, but not quite, as good as those obtained by Mr. Talbot's process.

Sir D. Brewster said, this was the germ of one of the most extraordinary discoveries of modern days; by it there seemed to be some thermal effect which became fixed in the black substance; and not only so, but M. Bessel informed him that different lights seemed to affect different vapors variously, so that there seemed to be something like a power of rendering light latent—a circumstance which, if it turned out so, would open up very new and curious conceptions of the physical nature of light. On the emission theory, it would be easy to account for this; on the undulatory theory, he could not conceive how it could be possible.

Professor M'Cullagh said, he believed Newton had somewhere thrown out a suggestion, that luminous particles, as they entered into bodies, might be caught and retained, within certain bounds, by continual attractions.

Sir D. Brewster said, that the experiments which he had performed with nitrous gas seemed to strengthen some such view as this, for, at certain temperatures, we had here an instance of a gaseous body as impervious to light as a piece of iron.

Sir J. Herschell thought it a pity to encumber this new and extensive field of discovery now laid open to them by any speculations connected with the theory, either of undulations or emissions. He had found that paper could be so prepared as that the impressions of some colors might became permanent upon it, while others were not; and thus it became possible to impress on it colored figures by the action of light. He exhibited a piece of paper so prepared, which at present had no form or picture impressed on it, but which was so prepared that, by holding it in strong light, a red picture would become developed on it. Mech. Mag.

Dr. Payerne's Sub-Aqueous Experiments.

Dr. Payerne repeated on Wednesday last, at the Polytechnic Institution, (for the third time,) his experiment of living under water without communication with the upper air. He descended in the bell precisely at eleven o'clock, and remained there without any other supply of vital air than that which he was able to manufacture for himself (the *how* is the puzzling question) for three hours. The temperature of the Hall, at the time of Dr. P.'s descent, was 74° Fahr., and a thermometer which he took down with him, and examined every quarter of an hour, exhibited the following changes:

Hour.	Thermometer.
11	67
¼	68
½	67
¾	66
12	65½
¼	65
½	65
12¾	65
1	65
¼	65
½	65
¾	65
2	65

Dr. Payerne states that the only inconvenience he felt was a slight stunning sensation on first descending in the bell, and on emerging from it, occasioned, no doubt, by the sudden transition from one degree of temperature and pressure to another.

Patents for the invention are now in the course of being applied for, and until they are secured, it is not to be expected that any public disclosure of the means made use of by Dr. Payerne will be made.

To demonstrate, in the meanwhile, the practical value of the invention, by a still severer proof than any to which it has yet been subjected, Dr. Payerne has made an offer to the Lords of the Admiralty, to go down *to any depth, in any place they may select, and to remain constantly submerged for the space of twenty-four hours.*

We think it probable their lordships may hesitate to be consenting parties to an experiment so certain, under any circumstances, to be of a very trying description—for nature must require the repose of sleep under water as well as above—and which, for anything yet known to the public, may be full of danger; but we may, at least, confidently reckon on their affording Dr. Payerne every facility and assistance within reasonable and prudent limits, for testing the working capabilities of his system. Ibid.

On the Calcination of the Chlorate of Potass.

At a late meeting of the Academy of Sciences, Paris, a communication was made relative to some experiments, by M. Milon, in the calcination of the chlorate of potass. Fifteen years ago, M. Serullas, professor of the Military Hospital of the Val-de-Grace, announced the discovery of the hypo-chlorate of potass, during the calcination of the chlorate. This unexpected fact excited, at the time, great interest among chemists, the calcination of the potass having long been an operation for the preparation of oxygen. The experiments of Serullas were, therefore, repeated, and were confirmed by all the chemists who performed them. The new formula of the decomposition of the chlorate, was regarded as explanatory of the march of the phenomenon. It appears, however, from the experiments of M. Milon, that something more was to be learned. He has ascertained that the hypo-chlorate of potass is not immediately transformed into the chlorute of potassium and oxygen, but into chlorite and chlorure. He was able to isolate the chlorite of potass, to produce the chlorites of lead and silver, and to prepare chlorous acid, of which he gives the following account: The chlorous acid, formed of one equivalent of chlorine and three of oxygen, corresponding as to its composition and properties with nitrous acid, is, under most circumstances, the most stable of all the compounds which chlorine forms with oxygen. M. Milon describes various means of obtaining it in the greatest state of purity. The most simple and elegant of these consists in treating arsenious acid with nitric acid, perfectly pure, and with the chlorate of potass, chlorous acid is produced with great facility. It is a more highly-colored gas than chlorine, but differing from it in most of its properties. It does not—which is a surprising fact—attack even finely pulverised arsenic, or the other metals which combine so powerfully with chlorine. Exposed to the action of the solar light, it is decomposed, and produces per chloric acid. In this experiment, the solar light acts both as heat and light. Heat alone, however, is capable of producing this result, but light without heat will not. The chlorous acid is slightly soluble in water, to which it communicates a yellow color, with an intensity which may be compared to that of the chlorate of potass. In solution it gives out a vapor, which is at first invisible, but becomes gradually visible, and at length assumes the appearance of a dense fog. A few drops of liquid, thrown into a jar filled with ten litres of damp air, suffice to render it perfectly opaque.

This phenomenon has particularly attracted the attention of M. Arago, who is of opinion that an opaque atmosphere may be produced at will, and thereby lead to the solution of most important problems on the polarization of light, which have hitherto not been resolved for want of the means of observation. The discovery of the chlorous acid is a fact of high importance. It completes the series of the combination of the chlorine and oxygen, and establishes an analogy the more between these compounds and the corresponding compounds of azote.

Mining Jour.

Improved Modification of a New Electrotype Process.

By M. Newsam.

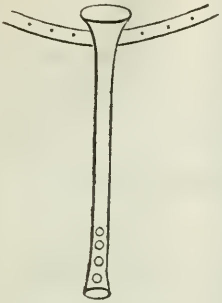
A discovery has been recently made of etching copper plates, by first gilding them by the electrotype, and then delineating the drawing through the coat of gold to the copper. I tried the gilding process several times, but could not succeed in producing a firm coat of metal; and I am acquainted with many scientific gentlemen who arrived at the same result—namely, a dirty black powder, easily rubbed off, instead of the "*glittering metallic surface of incomparable beauty,*" as it has been designated by some. Indeed I am half inclined to doubt that such a thing has ever been accomplished. My trials with the "noble" metals proving in every case a decided failure, I thought of trying what could be done by means of the cupreous deposit, as I always found it perfectly pure and firm, provided, only, care were taken in conducting the process. My first experiment proved quite successful; the subject of it was an ordinary steel plate. I covered it with a thin film of copper, which I afterwards etched, and bit up with dilute sulphuric acid. Far finer and closer lines can be formed on this ground than on that in general use at present, which arises from the latter being required to be laid comparatively thicker on, which, together with its property of adhering to the point of the tool, during the process, sometimes sends a whole body of fine line-work into a broken unmeaning mass. What I consider the greatest advantage attending working on a metallic "ground," is, that after the effect, &c., is bit in, the plate can again undergo the same process, if the resulting etching be not satisfactory—an object not to be attained by the employment of grounds of a waxy or resinous nature. Such grounds always require to be totally removed before the picture can be pronounced perfect—at least as regards the etching; and if the same be found, on inspection, to be not of the requisite degree of color, or depth of tone, the touching up is attended with labor and uncertainty. A plate furnished with a metallic ground, can, however, be bit deeper, even *after* a proof has been printed from it, the coat of metal, of course, being allowed to remain on the plate.

Mech. Mag.

Remedy for Spontaneous Combustion of Coals.

Captain Carpenter, of Her Majesty's steam frigate *Geyser,* has suggested the following remedy for spontaneous combustion.

It is proposed to have several cast iron tubes, with holes at the lower part, as shown in the following figure, passing into the bunker, or coal-hole, nearly to the bottom of the vessel, and only a few inches from the ship's side, properly secured. The upper parts of these tubes are to come up to the deck, and to be contrived so as to give ventilation without allowing wet to go down amongst the coals. At the same time, means are to be afforded of pouring water into the bunkers, so as to flood them at the bottom in case of ignition. The water, in that case, would have a twofold effect, as it would not only extinguish the fire at the place where danger is to be apprehended, but at the same time, the water poured into the tubes would destroy all ventilation, and have a tendency to smother the part ignited.



The cause of spontaneous combustion is, evidently, first, the accumulation of gases from the moisture of the coals; and then either heat or friction gives rise to ignition. To obviate this evil, if you allow the atmospheric air to pass freely amongst the coals, of course the gases could not accumulate, and combustion would not take place. If, however, there should be parts where the air did not penetrate, then the remedy is effected by pouring water into the bottom of the coal-box, and extinguishing the fire. The smoke issuing from the tube on deck, would always give timely notice of danger; and the hose on deck, pointed into the upper part of the tube, would provide a sufficient supply of water always at hand. The tubes would be about six inches in diameter, and about a quarter of an inch thick; their length would be regulated by the depth of the coal-box.

Hay-stacks are provided with the same remedy against taking fire, by introducing a large basket tube down the centre; and why should not the same result take place in the manner proposed? Ibid.

METEOROLOGICAL OBSERVATIONS FOR JUNE, 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
☽	1	52°	70°	29.90	29.96	W.	Moderate		Clear.	Clear.
	2	50	75	30.00	30.10	E.	do		Clear.	Clear.
	3	48	74	30.05	29.95	E. S.	do		Clear.	Clear.
	4	58	74	29.90	29.85	S.	do		Cloudy.	Cloudy.
	5	64	78	29 80	29.80	SW.	do		Cloudy.	Clear.
	6	64	73	29.75	29.80	W.	do		Cloudy.	Partially cloudy.
	7	48	67	30.10	30.15	E. SE.	do		Clear.	Clear.
⊗	8	48	69	30.25	30.25	SE.	do		Cloudy.	Cloudy.
	9	58	71	30.00	29.90	S.	do	.35	Rain.	Cloudy.
	10	63	75	29.70	29.70	W.	do	.20	Rain.	Clear.
	11	47	60	29.80	29.95	NW.	do		Clear.	Clear.
	12	40	70	30 10	30.10	W.	do		Clear.	Clear.
	13	52	76	30.00	29.95	S.	do		Lightly cl'dy	Lightly cloudy.
	14	62	70	29.90	30.00	E.	do		Clear.	Clear.
☾	15	64	71	29.96	29.96	E. SW.	do	.53	Rain.	Rain.
	16	66	78	29.83	29.83	SW.	do		Cloudy.	Cloudy.
	17	68	73	29.83	29.83	SW.	do	.05	Cloudy.	Rain.
	18	68	79	29.83	29.83	SE.	do	.17	Rain.	Flying clouds.
	19	69	79	29.70	29.70	SW.	do	.35	Cloudy.	Rain; cloudy.
	20	68	72	29.74	29.86	W.	do		Cloudy.	Cloudy.
	21	64	78	29.95	30.00	W.	do		Clear.	Clear.
☺	22	63	82	29.90	29.83	W.	do		Fog.	Cloudy.
	23	70	73	29.73	29.68	SE.	do	.08	Rain.	Cloudy.
	24	62	72	29.81	29.81	NE.	do		Cloudy.	Cloudy.
	25	62	67	29.84	29.84	W. S.	Brisk		Fog.	Cloudy.
	26	66	80	29.62	29.61	SW.	Moderate	.23	Rain.	Partially cloudy.
	27	68	74	29.58	29.90	E.	do	.14	Par. cloudy.	Rain.
	28	62	76	29.75	29.75	SW.	do		Cloudy.	Flying clouds.
	29	65	82	29.75	29.90	W.	do		Clear.	Clear.
☽	30	66	86	29.94	29.94	W.	do		Clear.	Clear.
		60.13	70.13	29.89	29 89			2.10		

Thermometer.		Barometer.	
Max. 86.00 on 30th, 27th &31st. Min. 40.00 on 12th.	Mean, 67.13.	Max. 30.25 on 8th Min. 29.58 on 27th.	Mean 29.89

SEPTEMBER. 1842.

Moon.	Days.	Therm. Sun Rise.	Therm. 2 P.M.	Baromtr. Sun Rise.	Baromtr. 2 P.M.	Wind. Direction.	Wind. Force.	Water Fallen in rain	State of the Weather, and Remarks.	
	1	64°	78°	30.10	30.10	S. SE.	Moderate		Cloudy.	Clear.
	2	64	80	30.00	30.00	W.	do		Clear.	Clear.
	3	69	82	29.95	29.90	SW.	Brisk		Cloudy.	Clear.
⊗	4	68	74	29.96	30.00	NE. SE.	Moderate	.45	Rain.	Cloudy.
	5	72	78	29.84	29.84	W.	do	.14	Rain.	Cloudy.
	6	62	74	29.96	30.00	NE. E.	do		Clear.	Clear.
	7	60	75	29.94	29.94	SW.	do		Cloudy.	Clear.
	8	64	77	29.90	29.90	SE.	do		Par. cloudy.	Partially cloudy.
	9	72	78	29.80	29.90	SW.	Brisk		Cloudy.	Cloudy.
	10	62	69	29.95	30.00	E.	Moderate		Cloudy.	Cloudy.
☾	11	62	75	30.00	29.90	SW.	do		Cloudy.	Lightly cloudy.
	12	72	85	29.73	29.73	W.	Brisk		Cloudy.	Clear.
	13	73	81	29.50	29.50	W.	do		Lightly cl'dy.	Lightly cloudy.
	14	63	65	29.85	29.84	NE.	Moderate	.45	Cloudy.	Rain.
	15	62	69	29.84	29.84	NE. E.	do		Cloudy.	Cloudy.
	16	60	67	29.84	29.86	E.	do		Cloudy.	Cloudy.
	17	54	69	29.90	29.90	W.	Brisk		Lightly cl'dy.	Clear.
	18	54	68	29.80	29.80	W. SW.	do		Lightly cl'dy.	Clear.
☺	19	56	66	29.80	29.80	NW.	do		Lightly cl'dy.	Lightly cloudy.
	20	48	62	30.00	30.00	W.	do		Clear.	Clear.
	21	48	65	29.85	29.70	W.	do		Lightly cl'dy.	Lightly cloudy.
	22	45	60	29.86	29.86	W.	Brisk		Clear.	Clear.
	23	40	57	30.00	30.00	W.	Moderate		Clear.	Clear.
	24	43	61	30.05	30.05	W.	do		Clear.	Clear.
	25	46	64	30.10	30.10	NW. E.	do		Lightly cl'dy.	Clear.
☽	26	47	67	30.13	30.14	W.	do		Clear.	Clear.
	27	49	70	30.14	30.10	W.	do		Clear.	Clear.
	28	52	74	29.93	29.85	W.	do		Lightly cl'dy.	Clear.
	29	56	72	29.90	29.95	N.	do		Clear.	Clear.
	30	56	65	29.96	29.90	E. W.	do		Cloudy.	Cloudy.
		58.10	70.87	29.92	29.92			1.04		

Thermometer.		Barometer.	
Maximum 85 on 12th. Minimum 40 on 23rd.	Mean64.485	Max. 30.14 on 26th. Min. 29.50 on 13th.	Mean 29.92

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